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ABSTRACT

This publication contains 4 reports and 15 profiles which illustrate the role of computers in education with emphasis on vocational education. The reports are: (1) "Microcomputers in the Classroom--Dreams and Realities" (Henry Jay Becker); (2) "Microcomputers in the Classroom: Are There Unique Issues for Vocational Educators to Consider?" (Judith M. Rodenstein); (3) "Microcomputer Instruction in Agriculture and Agribusiness" (D. W. Scheid); and (4) "Vocational 'CAD' Education at the Indian Valley Vocational Center" (Mark Schwendau). The profiles, which describe an institution's efforts to integrate the microcomputer into a particular curriculum are: (1) "Coordinating the Use of Microcomputers District-Wide"; (2) "Integrating Microcomputers into the Secondary School Curriculum"; (3) "A Computer Literacy Course at a Liberal Arts College"; (4) "Integrating the Microcomputer into a Business Education Curriculum"; (5) "Simulation of a Model Office"; (6) "Integrating Information Processing into a Business Curriculum"; (7) "Using the Microcomputer in a Basic Skills Program"; (8) "The Microcomputer in Agricultural Education"; (9) "Integrating Computer Assisted Design (CAD) into the Drafting Curriculum"; (10) "A Statewide Demonstration Site for Teaching CAD"; (11) "Generating Tests with a Microcomputer"; (12) "Enhancing a Printing Technology Curriculum with the Microcomputer"; (13) "Using the Microcomputer to Manage in a Secondary Level T&I Program"; (14) "Computer Managed Instruction in a Major Appliance Servicing Program"; and (15) "Using a Microcomputer to Control a Mill." Each profile contains the name, address, and telephone number of the contributing institution, the title of the instructional program used, and the name of the contact person at the institution. (JB)

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INSTRUCTIONAL STRATEGIES FOR USING MICROCOMPUTERS IN VOCATIONAL EDUCATION

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FOREWORD

This publication represents the efforts of many vocational educators who have successfully integrated the microcomputer into their curricula. The diversity of techniques and strategies used are illustrated in the profiles and reports.

The introductory papers discuss the role of the microcomputer in education, and then specifically in vocational education.

The profiles contain the name, address and telephone number of the institution, the title of the instructional program and the name of a contact person at the institution. A description of the strategy used to integrate the microcomputer into the particular curriculum follows.

Special thanks to those educators who have contributed their time and ideas to this project.

Judith M. Rodenstein

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Microcomputers in the Classroom--Dreams and Realities

By Henry Jay Becker

ABSTRACT

This paper addresses problems and possibilities associated with uses of microcomputers in the classroom and discusses these in terms of instructional techniques and social aspects of integrating computer activities into ongoing classroom environments.

Widespread excitement about using relatively inexpensive desktop microcomputers for student instruction needs to be restrained both by considering how computers might ideally help young minds develop and by considering how actual implementations of microcomputer equipment in classrooms are likely to be made in the near future. The paper concludes with a summary of recommendations for researchers, developers of computer-based educational materials, and school system administrators.

We should not predict or expect that the personal computer will foster a new revolution in education just because it could. Every new communication medium of this century--the telephone, the motion picture, radio and television--has elicited similar predictions that did not come to pass. Millions of uneducated people in the world have ready access to the accumulated culture of the centuries in public libraries, but they do not avail themselves of it. Once an individual or a society decides that education is essential, however, the book, and now the personal computer, can be among the society's main vehicles for the transmission of knowledge (Kay, 1977).

In the last two years, many educators have become excited about using the new generation of small, desktop computers, called "microcomputers," to assist teachers in classroom instruction and to broaden students' intellectual experiences. This excitement has been felt even by teachers and administrators who have never touched a computer. But it has also been shared by curriculum developers, computer scientists, and others who have tried for many years to apply the capabilities of digital computers to educational purposes and settings. The new microcomputers, although no more computationally powerful than machines on which computer-assisted instruction were first developed nearly two decades ago, are simpler to use, allow more responsive and interactive student-and-computer dialog, and, most significantly, are far lower in cost.

Despite this excitement about using the new microcomputers in schools--an excitement that is reinforced by commercial efforts to sell computers and computer program products to this potentially large and relatively centralized market--many people doubt that single or multiple purchases of instructional equipment costing hundreds or thousands of dollars per item can be justified in most schools unless unprecedented academic accomplishments can be expected to follow from their use.

There is reason to be skeptical, for example, that the current Apple and Radio Shack computers which many schools are purchasing are cost-effective devices for providing the remedial drill and practice of basic math and language skills for which the commercial advertisements so willingly tout them. Although computers do provide opportunities for individualization, immediate feedback, and summarization of individual student performance that other methods of skills practice may lack, it is not clear that these computers enable skills to be learned so much more rapidly that their investment is worthwhile on these grounds alone. The potential capacity of computers to diagnose student error patterns and provide corrective tutorial instruction—features which might more reasonably make computers cost-effective teaching aids—have rarely been demonstrated in current microcomputer-based learning materials.

However, it is not only the content of programs available for currently marketed microcomputers that raises questions in many minds. There are also important organizational and curricular problems to solve before the technology may be effectively used to increase learning efficiency in math and other subjects.

The most obvious organizational problem is that while most products developed for classroom uses of microcomputers allow profitable use by only one child at a time, schools typically purchase microcomputers in very small quantities—most often a single computer in a single classroom, perhaps later expanded to three or four. For teachers to effectively use a device which is primarily geared for a single user, when they have one machine and 30 children, demands a major planning effort.

Besides these practical reasons for skepticism about using computers in classrooms today, there are both empirical and ethical questions about the longer-term prospects for computer-use in classrooms. If "computer-assisted instruction" is still to be the primary function of computers in the classroom, one must ask whether providing a new method for having students practice applications of rote-learned rules of grammar and arithmetic is more important than using school resources to develop more higher-level intellectual skills of students.

Also, some people have questioned whether increased computer-based instruction will replace, rather than supplement, the learning time that is spent in an interpersonal context. If so, it may result in higher academic performance at the cost of diminished social skills. In large segments of the public, anything with the name "computer" is denigrated as inevitably producing mechanical, impersonal schooling; thus, the manner in which schools publicize their computer-related activities may also be a problem.

This paper explores both the DREAMS that are held for computers in the classroom and some of the REALITIES that these dreams must confront. In a future paper, I will suggest some positive and concrete considerations to guide the behavior during the next several years of those who would build computer-based learning tools and those who would purchase them. Throughout both papers, I try to keep in mind two basic questions: "What uses, if any, should we make of today's microcomputer products in today's classrooms?" and "What can we do to make microcomputers more useful to schools during the next five years?"

This practical focus is important because every week schools and school systems across the country, and manufacturers and developers of educational materials are making decisions which will affect the ability of computers to assist (or impede) the education of thousands of students. On the other hand, focusing only on the immediately possible is unnecessarily limiting. Without expanding one's attention to some of the more imaginative images of how computers might be able to function in education, there will be a tendency to evaluate current attempts to use computers in too limited a context. So I will begin with some dreams—some of the ways that computers might be used by children and adolescents in school settings—perhaps 10 to 15 years from now.

Dreams

Imagine a dozen second-graders seated in their classroom, each conversing with a personal "videopal." They speak to it in lowered voices, as they have been taught by their teacher, and their videopal, in turn, speaks back to them—instructing them, for example, to read aloud the next word or phrase displayed on the screen. The computer, personalized as a videopal, meanwhile assesses the child's performance level, recalls from its stored data information about the child's recent particular problems, and selects an appropriate stimulus for the next reading task. After the response, the machine examines the response for errors, announces gently how the words were to have been pronounced, and provides additional opportunities or examples as follow-ups. Meanwhile, the classroom teacher is circulating through the room, assisting students with problems that the computer lacks the flexibility to handle and helping the students to use this electronic learning tool effectively. Elsewhere in the school, fourth and fifth grade students are engaged in similar "dialogs" with "intelligent computer tutors," responding by using the keyboard that they had learned to master during the previous year.

The computers in this example communicate by using a stored body of knowledge of both subject matter and teaching method, emulating the behavior of a master teacher--knowing what kind of stimulus to present, how to evaluate the response, and what kind of feedback (both substantive and affective) to provide to assist the child's understanding and to maintain motivation for receiving future stimuli.

Now imagine a child in the same second-grade classroom--one who has become interested in the musical patterns and colorful designs that have been programmed into a "videobrush" computer available in the classroom learning center. Through the child's intrinsic interest in musical sound and color, she has learned to manipulate this device (which was programmed, of course, to encourage this manipulation) to create a music-and-color design of her own construction.

At the same time that the computer allows this "play" (i.e., self-directed activity not designed to yield a particularly known and generalizably useful skill), it explains to its user certain properties of color and sound and the human physiological apparatus that senses them, and it provides modifications of the child's construction and queries her about how these modifications might affect the result.

A brilliant intermixture of "instruction" and "play" maintains the user's interest, develops creative thinking, and assists in an understanding of a subject matter beyond the usual range of the second grade curriculum and even beyond the capacity of the teacher to explain or perhaps even to understand.

There are many other such dreams. For example, one image is of a multi-faceted computer display screen which the student (probably of high school age) has learned to manipulate to be a writing pad, a calculator, a dictionary, a thesaurus, and "windows" on a variety of reference works and news and information sources. The student develops expository skills and information retrieval skills using the kind of "paper and pencil" which will be available to her in the real world after schooling. She manipulates the keyboard in front of her with an agility coming from several years of experience using keyboard communications devices. She uses special keys to get the computer's help when she cannot remember or does not know how to use the computer facilities to accomplish a desired retrieval or information manipulation. The teacher, meanwhile, is freed to provide more scholarly assistance, helping the students improve their expository style and contributing editorial judgment, leaving the computer to assist the student with some of the more mechanical aspects of writing, such as syntax and spelling.

In another image, a high school physics teacher is trying to develop in his students an understanding of the history of scientific understanding of physical principles. Using a large-screen video display which the entire class can see, he demonstrates the behavior of objects sliding down an inclined plane with the objects' behavior conforming to an assumed mathematical equation. The objects, of course, are not real, but dynamic visual images which look real to any but the most discriminating observer. After learning how a mathematical equation relates to the object's behavior, the students are asked to suggest variations in the equation, and they come to a judgment about what equation best conforms to the behavior of objects in the real world. The teacher mentions in passing that without the computer's ability to create these simulated worlds where things behave differently than in the real world, the students could only accept the equations on faith, because proving them would require experiments much too complex and expensive to be done in a classroom.

In a final image, we find an average high school student of the future who has become bored with using the computer in pre-programmed ways to practice reading and language skills, create musical patterns, write school reports, calculate solutions to math problems and examine alternative simulation models. Instead, having learned the immense variety of information manipulation of which the computer is capable, the student is busily engaged in creating new functions for the computer for use in his own life or for someone else's.

This capacity to combine known computer capabilities into a new function or product is what is generally known as "programming" a computer. Many people believe that such skills are beyond the capability of the average adolescent, but those who have worked with students—as young as age 5 or 6—have come to the opposite conclusion. Programming, although requiring capacities of logical thought and abstract reasoning, itself generates intellectual growth in these skills, and is simply not quite so foreign to those who have used the computer in a variety of ways as to those not experienced in doing so.

Programming both requires and generates the capacity to perform logical operations on pieces of information, to structure information in a systematic way, and to creatively combine different pieces of information in a new and functional way. Low-cost computers, by being more available and accessible, may enable these capacities to be generated in a much broader population of adolescents than previously.

Each of these dreams is impractical today. Each demands from available computer technology, from commercial or internally-developed computer programs, or from teacher-possessed computer knowledge more than almost any school is able to obtain or provide. Nevertheless, the images contain most of the goals that those excited about the possibilities of computers in the classroom have in their minds.

(1) The ability of intelligent and communicative machines to provide appropriate instructional stimuli on an individualized basis, providing diagnoses and feedback both to the student and to the teacher-manager responsible for monitoring the student's progress.

(2) The creation of intellectually stimulating environments for teaching subject matter generally foreign to the current curriculum, perhaps beyond the competency of the teacher, but important and useful preparation for the world of the future.

(3) The resources of a highly complex but flexible information storage, retrieval, and processing machine—comparable to a library, a librarian, a typewriter and an editor—all accessible to the student and together providing necessary skills for the student's subsequent adult experiences.

(4) An appliance able to provide experiences and opportunities to students through simulations which would be otherwise too costly, too risky, too time consuming or not possible. People often learn best by participating in a system rather than merely being a spectator. Computers provide a way to get close to actual participation without the costs or risks of actual participation.

(5) A generation of young adults performing logical thought, processing information and performing analytic tasks far better than previous ones—due to an early and continuous exposure to concepts and methods of computer programming.

Although these classroom images are highly idealized, it is possible now to develop materials so computers could function in ways that resemble these scenes. Programs can be written and used to have children and adolescents explore music and art theory, to be tutored in arithmetical operations, to practice retrieving information from a computer's "data-base," to simulate social environments and scientific principles, and to test students' models of these systems; and classes can be organized to teach students to program computers.

Yet, practical implementations that use such programs, limited by available technology and funds, by the methods used to implement them, or by external constraints such as teacher skills or institutional inertia, could all be pale imitations of the ideal and may deliver none of the promises so appealing in the original image. It is important to consider which kind of implementations schools are able to make today using available equipment, realistic budgets, and current manpower and expertise, and to begin with these limitations to develop materials and methods of implementing them that will optimize the contributions that current microcomputers can make to life in schools.

The Realities

About 45 million students are enrolled in elementary and secondary schools in the United States today. These are grouped into about 2 million classrooms and 100,000 schools. Somewhere between

15,000 and 30,000 schools have at least one microcomputer or terminal connected to a larger computer—about one out of every four schools. The total number of such computers and terminals can be reasonably estimated to be between 20,000 and 50,000—about one computer for every 33 to 100 classrooms.

Of these classrooms with computer facilities, more now have stand-alone microcomputers than terminals connected by telephones to larger computers elsewhere (National Center for Education Statistics, 1981). Most of the terminal systems are older and many are being replaced by microcomputers. (Infoworld, Dec. 7, 1981, p. 9.)

The number of schools with microcomputers is increasing at the rate of about 30% to 50% per year, but the numbers are still small compared to the number of students or even the number of classrooms. Even with a 50% annual increase in microcomputers (and no change in the number of functioning older pieces of equipment), by 1986 there will be only about three computers per school or one for every eight classrooms. It is important to keep figures like these in mind—even if they are only vague forecasts—when considering how computers can or will impact on classroom education.

For example, even if schools or districts commit one percent of their operating budgets for five years in a row to purchase microcomputer equipment—this is about half of what most schools spend annually on books, workbooks, and the like—by 1986 there would still be only one or two computers per classroom. Even at that rate of spending, which is beyond what is expected by the computer industry, there would hardly be enough computer equipment to drastically alter the way most instruction is given to the average student.

Anecdotal published reports of teachers using computers in their classroom, as well as published statistics on computer ownership by schools, confirm that schools typically acquire computer equipment for instructional purposes when a single teacher undertakes responsibility for management of a single microcomputer. There are some instances of administrative initiative, and certain states or school districts are pilot testing the use of microcomputers, but the most common etiology is for an enthusiastic teacher to obtain local school funds to purchase a microcomputer for his or her classroom. Secondary mathematics teachers appear to the most frequent enthusiasts.

A PILOT INTRODUCTION TO CLASSROOM COMPUTING WITH ONE MICROCOMPUTER

To see how typical teachers would use a single microcomputer in the context of classroom-organized learning, during the 1980-81 school year the School Year Organization Program at the John Hopkins Center for Social Organization of Schools provided six local teachers with a Radio Shack TRS-80 personal computer for a several week period. The computer was used in three upper elementary classrooms and three junior high mathematics classrooms. It was used primarily to expose students briefly to computer programming activities, rather than as a tool for students to practice their regularly taught math skills. This pilot effort was evaluated informally through periodic observation and conversations with teachers during the time they used the computer.

The students ranged from somewhat-below-average in current math performance to somewhat-above-average. In one of the six classrooms, the same students used the classroom for most of the day. In the rest, students had access to the computer only when their class was scheduled, generally for about an hour per day. The computer was present in each classroom for a three week period.

None of the participating teachers had had previous exposure or experience with computers. Three of the teachers were given a three-day workshop in Basic Programming prior to the fall semester. The other three participated in a 16-hour workshop in programming provided by the school district. All teachers had an opportunity to have the computer at their homes for a full week before they used the computer in their classroom. The teachers appeared to have a modest but sufficient understanding of programming techniques and vocabulary by the time they used the microcomputer in the classroom.

In each case, the teachers decided how they wanted to present lessons using the computer. They developed dittoed classroom assignments, homework assignments, and tests modeled on some of the materials that previous teachers borrowing the equipment had produced. The teachers were provided with a few programs for computer-assisted mathematics instruction, but none chose to use them because they did not provide practice on the specific skills currently being taught.

The students were taught programming using the computer language "BASIC." Previous experience with younger students had suggested that 5th grade was approximately the youngest grade level at which BASIC programming could be taught with the usual methods and expectations. This was confirmed in this pilot project—the 7th grade students made significantly greater progress in the three weeks of classroom use than the elementary school students. On the other hand, the class of

9th grade math students showed a much lower level of engagement in computer interaction and did not progress through the material as well as the seventh graders. Overall, student progress in learning computer programming over the three-week experience was limited, at best.

Most instruction was provided by teacher lecture followed by individual seat-work and by individual or group work at the computer keyboard. Because of the student/computer ratio (approximately 30-1), each student had about 10 minutes, on the average, of actual computer time over the three weeks of "access" to the computer. Clearly, the learning was primarily through seat-work and other traditional means rather than through interactive work at the computer. The computer served mainly to verify that one's product (a computer program) could actually produce an outcome (computer "behavior") that could be observed. The variety of actual experience "on" the computer was drastically limited by resource availability.

The two teachers who taught groups of children who varied widely in current mathematics performance both found clear differences in how quickly the groups could learn the programming material. Both had been asked to use their judgment in providing the programming unit to the lower-performing student classes, but both chose to do so apparently for two reasons: they regarded the unit as an enrichment opportunity that they did not want to deny the slower-learning groups; and having to learn a new subject-matter themselves—computer programming—they felt it was too time consuming to have to continue to prepare regular lessons for the slower groups at the same time they were developing the programming lessons.

Summarizing their experiences, all teachers expressed satisfaction that they had interrupted their regular curriculum to provide the computer's "enrichment." Most found the intellectual demands on themselves to be great, but worthwhile. Every teacher expressed the opinion that a single computer was insufficient to allow students to progress at the pace they could assimilate the new material. This insufficiency of resources for class-based computer instruction was the most important and most universally felt problem.

Despite the difficulties they had experienced with trying to integrate the use of a single computer with classroom-level instruction several teachers subsequently tried to obtain a computer for their school. In each case, only a single computer was contemplated, due to anticipated financial constraints.

The problems faced by these pilot-test teachers may not be representative of the problems that most teachers face when trying to use a computer in their classroom. But certainly, student access time must be a significant problem that arises in all but the most elaborate implementations of computers in the classroom—regardless of whether the computer is being used to teach programming or to provide drill work. In fact, using the computer to deliver instruction or practice in basic skills typically requires a higher ratio of computer stations to students than does using the computer as an "object of instruction." This is because programming activities involve a lot of "seatwork" such as learning appropriate vocabulary, planning a programming solution to a problem, writing the programming code, and "debugging"—finding errors that show up when the program is actually run at the computer.

SIX MAJOR INSTRUCTION-RELATED USES OF COMPUTERS

Having too few computers to effectively organize classroom instruction around them is not the only problem faced by schools trying to implement an instructional program that involves the computer. Other important issues faced by these innovating schools are (1) the marketing sophistication of educational merchandisers in contrast to a comparatively inexperienced user population, (2) the limited capabilities of the programs sold as computer-assisted-instruction and the limited capabilities of the computers bought by the schools to use for instruction, and (3) the almost complete lack of knowledge about computers by practicing teachers and the likely existence of this deficiency for perhaps another generation.

Some of these problems are general, affecting schools and teachers regardless of how they attempt to use computers in their classroom. But many of the problems are related specifically to the particular way that teachers attempt to use this versatile tool. Most instructional uses of computers can be considered under six headings:

(1) DRILL-AND-PRACTICE: Using computers for student practice of skills whose principles are taught by the teacher in traditional ways;

(2) TUTORIAL DIALOG: Using computers to present information to students, diagnose student misunderstandings, and provide remedial instructive communication and individually-designed practice;

(3) MANAGEMENT OF INSTRUCTION: (tied either to computer-based drill-and-practice or to a separate test-scoring system—or independent of either one) Using computers to provide the teacher with automatic reporting of individual student performances and appropriate assignment of skill levels;

(4) SIMULATION AND MODEL-BUILDING: Using computer programs to demonstrate the consequences of a system of assumptions, or the consequences of varying an assumption,

usually in conjunction with instruction in science or social studies;

(5) TEACHING COMPUTER-RELATED INFORMATION SKILLS: Using the computer to teach students and have them apply such skills as typing, editing text, and retrieving information from computer systems;

(6) TEACHING COMPUTER PROGRAMMING: Having students learn to program computers to solve problems that are a part of their mathematics curriculum or simply for the understanding or programming itself.

This list of educational uses of the computer could be stretched, but these six encompass the most common current expectations that people have for classroom instructional applications.

COMPUTER-BASED DRILL-AND-PRACTICE

Both computerized drills and tutorials are variants of a general category of computer use called "computer-assisted-instruction," or C.A.I. The element common to all C.A.I. is repetition of similar exercises and immediate reinforcement (cognitive and affective feedback regarding performance). The more elaborate drill programs divide the instructional program into discrete tasks where progress from one task to another depends on a student's prior performance. Tutorial programs also include (1) an analysis of incorrect performance, (2) detailed instructional feedback to the student and teacher, and sometimes (3) the use of a drill designed to overcome the identified weakness. Tutorial programs typically minimize repetition of exercises in favor of a more rapid sequence of problem, evaluation, feedback, and sequence determination.

For most people, using computers for instruction in the classroom is synonomous with computer-assisted-instruction. Programs to drill students or to examine student responses and provide appropriate feedback are the most easily conceived applications of computers for classroom use. Most research on computers in education has centered around C.A.I. curricula and delivery systems; and most products marketed for educator/consumers have been C.A.I. products.

There are several reasons for this "natural" association between computers and traditional instructional activities for teaching math, reading, and language. First, these basic skill subjects require repetitious practice and memorization of isolated facts and skills. The most limited resource in the classroom—the teacher's attention and response to individual student needs—is often taken up directing and monitoring this practice activity, instead of pursuing other instructional efforts that require the broader and more flexible intelligence that people—not computers—can best provide. Having a computer present problems, accept student responses, provide feedback, and measure student attainment is one way to free the teacher for these more uniquely "human" functions of instruction.

Of course there are other procedures for drill that do not require constant teacher attention. Individual student workbooks and ditto sheets allow simultaneous student drills at a cost which may be a heavy burden on discretionary school budgets but which is substantially less than the cost of computer-assisted-instruction. Programmed versions of these workbooks—providing feedback to the student and routing the student to remedial instruction or the next instructional level depending on performance—would appear to be superior to regular workbooks, but they require more cooperation from students and are more expensive to produce. Programmed instruction was popular some years ago, but enthusiasm waned when research failed to show substantial student improvement over other teaching methods. In addition, heavy reliance on programmed instruction was boring to students—a common problem of most individualized instruction (Morgan, 1978).

Computer-based programmed drills hold several advantages over less automated forms. Their interactive nature and their flexible and visually appealing display formats make them more enjoyable experiences. Student feedback is direct and immediate. Automated management can be built in to give the teacher a summary of the student's achievement. And whereas traditional programmed instruction usually directs students to subsequent stimuli based on the correctness of the immediately preceding response, the computer can use a summary of the student's entire history of problem-solving to select the best route for that student. Of course, not every drill and practice program builds in all these capabilities.

Another important reason for the strong "historical" tie between drill practice and "computers in the classroom" is that compared to other types of programs, drills are easy programs to write—particularly in mathematics or in subjects where multiple choice items can be used. The production can even be automated, so that teachers can "write" drill programs without learning to "program" the computer in traditional "procedural" computer programming language. Of course, the more automated production systems and programs dashed off with little effort are less likely to include precisely those features which give computerized drills an instructional advantage over alternative methods—management and teacher feedback, variability in display format, and computer-to-student communication.

Because drill-and-practice programs are easier to write than most other kinds of instructional programs, and because many standard areas of the school curriculum involve a lot of repetitive practice of examples of discrete concepts, both supply and demand make drill-and-practice the most commonly produced computer-based learning materials. These two factors, along with the greater standardization of the curriculum in the lower grades, have channelled most educational software toward the younger grade levels. This is so despite the fact that market surveys show clearly the most frequent purchasers of microcomputers for the classroom are high schools. Apparently, producers of software (computer programs) are trying to create a market for C.A.I. in the lower grades rather than trying to develop products for small, but existing, markets in the upper grades.

Research on Effectiveness

Drill-and-practice may also be attractive because major, systematic, well-monitored evaluations have found that computer-based drills can produce increased student achievement in comparison to prior years or in comparison to control group treatments. These positive research results have been found often in mathematics instruction, less frequently in language learning.

Vinsonhaler and Bass (1972), reviewing computer-based drills that pre-dated microcomputers in the classroom, concluded that C.A.I. drill-and-practice at the elementary school was more effective than traditional instruction in raising standardized test scores in the majority of 30 experimental comparisons at 10 sites.

Jamieson, et al., (1974) found that C.A.I. drill programs are particularly effective for students who start below grade level. They conclude that at the elementary level, C.A.I. is "apparently effective as a supplement" to regular instruction, although they imply that it may not be more cost-efficient.

ETS's evaluation of the drill-and-practive curriculum tested in the Los Angeles schools (Ragosta, et al., 1981) found that C.A.I. had a positive impact on computational mathematics, but increases in conceptual understanding of math were sometimes greater and sometimes less than for control group students. Also, language and reading results were less positive than the mathematics results, although students in the middle elementary grades did show strong improvement. The overall superiority of the results for math compared to language arts may be due either to differences in the ability of computer-based drills to provide useful practice or to differences in the quality of the particular C.A.I. curricula used.

However, this difference parallels the results generally found in the literature. Melmed points out that C.A.I. more closely simulates practice of math than practice of reading or language use. Equally important, perhaps, is that language and reading are used throughout the school day; thus C.A.I. language exposure is more limited relative to total exposure than is C.A.I. math experience (Melmed, 1980).

Even if computerized drills are more effective than traditional direct instruction, the issue of cost must still be addressed. At some point, the decision must be made about how much money more efficient progress in math or language achievement is worth. Clearly, for example, individual human tutors would produce increments in student achievement higher than that obtained by traditional classroom teaching. Just as clearly, school systems do not have the money to provide a tutor for every child. Computer use must be put to the same test. The computer must show a magnitude in improved learning efficiency that justifies the money investment and the investment of time and effort.

If we defer, for the moment, the concern about cost-effectiveness and limit ourselves to the problem of educational effectivenss, we still must question whether computerized drill programs will be effective additions to classroom instruction. The limited evaluation research shows that computer-based drill programs can be effective—given enough equipment for each child to have sufficient access and given appropriate content, organization of classroom activity, and monitoring. However, most of this research has been done under organizational conditions that allowed many computers to be in use at one time. Most involved use of time-sharing computer terminals rather than independent microcomputers, and were heavily monitored and well-managed implementations. Research should be conducted to determine whether most of the more typical drill-and-practice materials available for the TRS-80's, Apple's, and other microcomputers the schools are now buying, are as educationally effective under more typical conditions of use as were the pioneer C.A.I. programs.

Problems With Microcomputer Software

Two defects appear to predominate in current microcomputer software. First, most educational software is written in short, disconnected modules that are unrelated to one another and not clearly tied to other instructional activities or to specific textbooks. Second, most programs are boring and repetitious.

The first defect is due primarily to how the software is produced. Producers of most software for schools fall into four groups. First, teachers develop programs for their own use and then sometimes try to market their product. Much of the program library of the Minnesota Educational Computing Consortium has been built up in this way. Secondly, some program products are developed by programming teams within central offices of large school systems. The work of the Dallas and Philadelphia school systems, for example, is marketed by Radio Shack for their microcomputers. These efforts tend to be on a grander scale, but are less frequent.

Thirdly, microcomputer drill-and-practice software for schools is produced by a large number of non-teaching programmers who use their home computer as a source of additional income. Sometimes these programmers combine into teams and take on a more professional public image, but most product lines are the work of one or two individuals. Fourthly, corporate enterprises, primarily publishers, sometimes form software development teams of programmers and curriculum designers in-house, but more frequently they buy out or distribute the products of independent program authors. The publishers' drill-and-practice products are a mixture of small stand-alone programs and programs that attempt to provide a complete package of instruction on a single subject for a wide range of initial achievement levels. Still, even these full-scale packages tend to provide limited approaches to the subject matter which they do cover. The programming effort required is still large, even for drill-and-practice, and the pressure to market a product covering as much curricular territory as possible limits efforts to produce variety in the topic areas that are covered.

Two other related factors—low risk and low budgets—may contribute to the production of curricular fragments rather than complete, text-integrated tools. Due to major concerns about software copying, most publishers and distributers do not provide examination copies of educational computer programs. Thus, schools must often make decisions based on written advertisements and program descriptions. It is less risky to purchase individual programs costing, say, under $40 than to purchase a complete package at $400. Also, local budgets cannot usually absorb major software purchases, particularly after so much money was expended on the computer hardware! If schools emphasize hardware purchases more than software purchases, they may end up having computer equipment with capabilities that they cannot afford to implement. The survey of school microcomputer users planned by our Center during 1982 will provide more data about the etiology of school decision-making in this area.

The second practical deficit of most published computer drill materials is that, like the programmed instructional workbooks they often emulate, they tend to be boring and repetitious. The ETS's recent study of C.A.I. in Los Angeles schools found "boredom" as the objection to the program most often voiced by the participating children (Educational Testing Service, 1979). While observing children engaged in computer-based drills, one gets the clear impression that for them it is merely another assignment performed with little enthusiasm or care. In contrast, the same children are excited and enthused using the same computer to solve a puzzle or avoid an enemy's gunfire. Some drill implementations do attempt to combine the learning exercise with play activity. Banet (1978) reports the following two examples of game-environment-enhanced drills.

(1) An "estimation game" where feedback about accuracy of estimates is given by showing the distance from the bullseye of a target. Points are scored based on accuracy and speed of the estimate. This activity can be played by multiple players in competition with each other, or solitarily, in competition with previous high scores.

(2) Files containing the recognized vocabulary of individual students are used as individually-tailored data bases for word games. Each file can be automatically augmented by words used in the students' own computer-entered textual compositions.

The question is whether it is possible to create effective drill activities which minimize boredom and are as engaging as the play activities that the children enjoy. Based on an extensive analysis of computer games that children find "intrinsically motivating," Malone (1980) anticipates creating environments that maximize both learning and enjoyment.

Malone suggests that three factors be considered when designing motivational learning environments. First, the activities should be built around fantasy images that are meaningful to the intended audience. If possible, the learning required of the student should be "intrinsic" to the fantasy rather than simply added on. The example which Malone used in his research was a modification of a numerical estimation game developed originally for the Plato time-shared classroom computer where students "throw" darts to pop balloons along a number-line by estimating the point along the line at which the balloon was placed. In addition, Malone suggests that because different fantasies appeal to different people, the learning activities should be imbedded in different play situations with the particular environment used left up to each student.

Malone's second motivational principle is that the activities should contain a variety of challenges and goals that appeal to students of different ability levels and different motivational structures. Also, the goals should change as the student progresses, so that the uncertainty of success is maintained at a small but constant level.

Related to Malone's emphasis on challenge is the element of "curiosity," which is heightened by maintaining the relative amount of information and mystery in the environment. Feedback from the computer regarding student actions should encourage further exploration by providing new questions as well as new understanding. For example, in the computer recreation known as "adventure games," travel through an initially-uncharted maze is accompanied by both further information about the maze and its "dangers" and further questions about how to best proceed. These games may serve as a prototype for the design of educationally useful explorations of a substantive rather than physical maze.

Although Malone's suggestions appeal to many, others may feel that turning learning into play is, at best, inefficient and, at worst, destructive of the self-discipline required for future learning. Development of instructional activities incorporating such motivational features should be accompanied by research which evaluates these components empirically.

Computer-Based Drills and Educational Theory

Beyond practical questions about whether computer-based drills will be successfully integrated with the textbook-based curriculum or whether they will be as motivating as alternative drilling methods, and beyond questions about their effects on achievement test scores or their effects on the school budget, the use of computers as drill-masters raises questions of educational philosophy and curriculum theory.

Many people feel, for example, that drill-and-practive activity is already over-used by teachers. After all, repetitive drill is most useful only when the student already knows the relevant principles and procedures, and when the skill to be mastered is merely applying the principles and procedures accurately and speedily. If a child mistakenly thinks he understands how to do the math or grammar exercise, or if he does not know how to attack the problem and is "just guessing," repetitive drill on similar problems will reveal, at most, the level of understanding the child has--i.e., it serves as a testing instrument, not a teaching aide.

Most drill programs provide only approval for correct answers and mild disapproval for incorrect ones. Howe and DuBoulay (1979) suggest the superiority of providing "information feedback" that tells why the answer is wrong and/or what the correct response should be. Also, such information may be provided at each step in the problem, rather than solely at the final solution. They refer to a study by Tait, Hartley, and Anderson (1973) which found that information feedback produced performance superior to mere reinforcement feedback.

Howe and DuBoulay also find that students become frustrated and begin to respond randomly after some exposure to drill programs that do not provide assistance in learning to solve the problems. Of course, merely giving the correct answer without helping the student understand errors may produce other behavior that is not conducive to learning, such as making any immediate response in order to get the correct answer to appear on the screen.

A related philosophical criticism is that C.A.I. exaggerates an already overgreat emphasis on the learning of facts. Facts, after all, are more easily translated into computer programs than are conceptual ideas. The student, according to this view, is already too often called upon to provide the "right" answer to someone else's question, while little emphasis is placed on encouraging students to ask questions, to organize their ideas, to apply their understanding to new situations, to learn to work productively with their peers to accomplish planned goals, and to learn how to improve their learning skills (Garson, 1980). Drill and practice on the computer, rather than helping students expand their intellects, conditions them to regard the computer as a rather boring tool of the teacher over which they have little control.

However, the critics of drill and practice may have an idealized picture of what kind of instruction is necessary to enrich children's capacities to learn and to relate to others. When pressed, the critics would probably agree that knowledge of spelling is necessary to communicate, that possession of a larger vocabulary is essential to ask appropriate questions, and so on. And the kinds of instruction needed to provide these basic skills are often fairly mundane tasks involving introduction of small pieces of new material, concept formation, practice, and review.

Therefore, if "higher order" activities depend on knowing basic language and math skills, using the computer to deliver this instruction can be an alternative to rather than an extension of the time devoted to drill work. The primary question is whether computer-based drill is more educationally effective and more cost-effective than other ways of accomplishing this result.

The factors previously discussed are ingredients of an appropriate answer to this question, but the final outcome will vary for schools that have different financial resources, and the outcome is likely to change over time as the cost of computing continues to decrease. Now, most schools can afford only a limited number of the mass-marketed microcomputers. In addition, the available drill-and-practice software has limited coverage of a given school year's curriculum and, in most cases, is inadequately integrated with other curriculum materials. Also, we lack concrete information about the educational effectiveness of particular programs available off-the-shelf. Given these circumstances, I believe it is wise for schools to wait for future developments. Developers of drill-and-practice materials must begin to address classroom organizational issues in their system designs. Being practical, they should build these educational software systems for use in computers that will be available in the near future—perhaps for a 1985 generation of $200 handheld computers. Given enough time, the utility of computers to effectively and efficiently increase student achievement in computational arithmetic and language skills may be fully demonstrated. However, if schools invest too much too soon, the disappointments may prevent products from having a fair opportunity to prove their value.

TUTORIAL COMPUTER-ASSISTED INSTRUCTION

The distinction between drill-and-practice C.A.I. and tutorial C.A.I. is arbitrary. Drills shade into tutorials as the mode changes from repetitive computer-asked questions and student answers to the presentation of new information displayed on the computer screen; inclusion of more conceptual ideas instead of pure practice of examples; and use of a more complex logic to examine students' patterns of response, analyze errors, and determine appropriate informational feedback and sequence of problem presentation.

Minimal tutorial dialog can be written using a limited number of programming statements that display information and questions, accept the student's response, compare the response with the "right" answer, and branch to a remedial information display or the next sequential information display depending on the appropriateness of the student's answer. At the other extreme, a tutorial program can attempt to model the student's understanding of the subject matter and provide a dialog based on this analysis. It may determine, for example, the optimum point at which to offer hints, what kinds of hints to provide, and how much to emphasize concepts relative to examples. This type of tutorial system is often called "intelligent C.A.I." A third tutorial model, embodied in one of the two major N.S.F.-funded computer-based curriculum projects of the 1970's (TICCIT), is based on the notion that students themselves are best able to determine when help is needed, whether examples or concepts are needed next, and how much to practice any given concept before asking for the next instructional material.

This approach, called "learner control," is used in TICCIT in several ways. Students are provided with displayed "maps" of the course, unit, and lesson terrain, with associated performance status measures. Generalizations and instances are explicitly classed as easy, medium, and hard—both in the expository mode and in the problem-solving mode—and alternative levels of difficulty are available for the student at any time. Help is available to the student in the form of further explanation related to each instance. Keyboard keys are reserved for various functions and options such as RULE, EXAMPLE, PROBLEM, HELP, MAP, and ADVICE. The ADVICE option contains information provided for the student by an advisor who has examined the student's performance. Test files are written for each lesson. The general rule about student choice is that no new instructional material is presented until the student requests it (RULE). Beyond that freedom, the TICCIT system also provides student choice over the alternative sequences.

Alternative designs are possible, however. One could give the computer preemptive or default power over the sequence of presentations within any given lesson or module (Bunderson, 1974); or, the ADVICE key could allow the system to recommend what the student should do next without actually exerting control over the sequence (Merrill, 1980).

A major problem in tutorial programs, as with teaching of any kind, is knowing when to intervene in the student's thoughts and behaviors. Providing information can help the student avoid fruitless guesswork and provide a more efficient "debugging" of the student's theoretical understanding. On the other hand, one may be preventing the student from learning through self-discovery. It seems likely that the more that a student develops an understanding of a problem without being told certain essential facts or relationships, the more thoroughly understood the problem is, and the more easily it may be applied elsewhere. Nevertheless, although it is appealing to give students control over the sequence of problems and "hints" given by the computer, it is not clear that students have a good enough model of what they need to study next or when it would be intellectually productive for them to receive a "hint."

When tested empirially, learner control has not proved to be more effective at increasing achievement than the more traditional ("adaptive") C.A.I. in which the computer programs choose the sequence of tasks (Merrill, 1980, Grubb, 1977). An argument can still be made, however, that learner control helps students gain skills in learning how to approach new learning tasks, and that these consequences are not measured by the research that has compared various tutorial models. Gagne suggests that the proportion of instruction that should be under learner control is a function of age and grade level (quoted in Hickey, 1974).

Some questions concerning TICCIT tutorials apply to other tutorial models. Tutorials involve a great deal of verbal presentation on the computer display screen. Yet reading vertical material on display screens, particularly through the less expensive video display units used in the computers that schools tend to buy, is not as comfortable for most people as reading from a book. One possibility may be for the tutorial programs to direct students to off-line reading from texts for expository material or even problem presentation. However, if the computer is not determining the sequence of materials (this is determined by the student under learner control principles), one is left only with computerized drill and feedback.

Another problem with heavily computerized dialog is that most students are not yet facile with keyboard communications. Gagne feels that having to communicate to the computer through a keyboard and video display is "one of the biggest bottlenecks in the whole business" (quoted in Hickey, 1974). The greater the tutorial's capacity for dialog, the more that typing skills, spelling proficiency, and the ability to follow directions become prerequisites for adequate use of the computer.

The most problematic aspect of tutorial C.A.I., though, is not related to the user's competencies but to the computer program's competencies. Using computers successfully to direct appropriate sequences of stimuli to the student requires a clear understanding of how people acquire skills and knowledge. For computer-based instruction to be effective, the programs must incorporate into their procedures the sequences of material, response-contingent alternatives, user-controlled options, and feedback mechanisms that promote learning for the greatest number of students. Yet, as Ellis points out, "even the best teacher does not know completely what it is that makes him a good teacher" (Ellis, 1974). Therefore, our ability to create computerized interactive procedural environments is limited by what little knowledge we have about optimizing instruction.

Some basic principles of learning are obvious: instructional methods should involve students actively in the learning process; practice is a major element of learning; correct performance should be reinforced; and student motivation is an important affective component that affects the efficiency of cognitive learning.

But knowing these principles of learning does not help a great deal in formulating and developing computer programs that would improve learning effectiveness over traditional methods. Brown (1977) enumerated several practical problems that have to be addressed before fully "intelligent" computer-assisted instruction can be realized: (1) A practical theory of hints: Suppose a student has no idea about how to solve a problem. What information should the computer provide? (2) An algorithm of hints that makes them a function of the skills an individual student has mastered and those he has not: Suppose the student solves part of the problem, but gets stuck. (3) A theory of interference: Suppose a student begins to make errors while solving a problem. Should the computer stop the student as soon as the first error is made, or at what further point? (4) Appropriate limitations on computer intelligence: Intermediate steps of a student's solution may not necessarily be provided to the computer. Yet an intelligent tutor may be able to deduce the intermediate step which caused the error. Should the computer be provided with the same kind of skills?

The teacher's capacity for performing these kinds of tutorial interventions is clear. The computer's is not. The scholarly and programming effort required to improve tutoring abilities of computers could involve lifelong careers in and of itself. The microcomputer programs now being marketed have few of these intelligent features.

The practical question now is whether the simplest tutorial programs, combining a presentation of facts, multiple-choice questions, and and response-contingent branching, provide useful instructional advantages.

Simple instructional tutorial programs are available for microcomputers in a variety of subjects from astronomy to zoology. However, most are isolated exercises that cover only a small portion of textbook material. Some of these programs may provide an innovative way to study one portion of the semester's work, but by themselves would hardly justify the purchase of microcomputers as instructional tools.

Even the simple tutorial C.A.I. programs are few in number, perhaps due to the large volume of programming and writing required to produce effective verbal dialog on the computer. Uttal (1969) believes that the most limiting aspect of "canned tutorials" is their dependence on a large dictionary of material. First, the task of entering dialog into the computer, specific to particular vocabulary and problem sequences, is very time-consuming. Secondly, it is "remarkably tedious" to anticipate all the dialog needed to carry out an instructional conversation based on all combinations of prior and current student response. "This programming bottleneck has been squeezed through only occasionally, and then by an almost brute-force approach which has seen marginally qualified people actually becoming the direct authors of widely distributed teaching materials." (Uttal, 1969; p.2)

Beyond the practical problems, Uttal sees a basic theoretical limitation to producing a "completely adaptive conversation, for it is impossible to conceive of a completely adequate dictionary." He compares this type of tutorial system, which he calls "selective computer teaching machines," with pictographic language systems of the Far East. In both cases, the limitation is the lack of generality in the scheme used to represent concepts.

A similar distinction explains the greater adaptability of computers for use in mathematics, and secondarily in science, than for use in language, social studies, or other instruction. Concepts in math and science are smaller in number and represent greater levels of generality than everyday linguistic discourse and the verbal symbols used in studying subjects such as history and literature.

Uttal's phrase for using more powerful computer programs in subject matter instruction is "generative C.A.I." Generative tutorial systems attempt to model the behavior of human tutors, in contrast to procedures such as programmed instruction, which model the end result (vocal utterances) of tutor thought processes. "We must always remember that the human tutor does not operate in the fashion of a table scanning device—i.e., s/he is not a dictionary user. Rather, s/he is an analyzer and generator who determines what the student's needs are, and then from some general set of rules or heuristics formulates a sentence, a problem, a diagnostic, or a remedial unit" (Uttal, 1969). Uttal felt, in 1969, that only mathematics, the physical sciences, and perhaps music were amenable to tutorial programs. It is not clear that things are substantially different twelve years later.

Thus, tutorial computer-assisted-instruction, however appealing, may not be particularly practical, except for limited use in mathematics or science. Displays must be highly specific to a particular dialog history in order to present appropriate comments and make appropriate branching decisions. This requires very large programs and time-consuming programming. To keep to a reasonable size, tutorial programs must be limited to "understanding" only a fraction of possible student verbal responses or the program must cover a narrow range of material. The potential value is great, but simply producing more C.A.I. programs will not help realize that potential. We must learn how to produce better programs. As Ellis commented, "James Moody is a musician not because he plays music but because he has the capacity to play music ... It is a variant of this notion to believe that the more we do with computers in education, the greater will become our capacity to computerize education and nowhere is this self-deception greater than it is among the advocates of tutorial C.A.I. ..." (Ellis, 1974 p.62)

MANAGEMENT OF INSTRUCTION

School districts use computers for functions other than instruction. They may use computers to manage and report student attendance and classroom enrollment, to complete payroll and other accounting functions, and to manage materials and supplies including, for example, library books. For these purposes, using microcomputers or combinations of microcomputers and central office computers linked by telephone lines is an efficient and convenient alternative to other automated or manual procedures. This paper will not discuss such uses. However, automating these administrative functions clearly requires fewer computers per school than the number required for computer-assisted-instruction. Schools that purchase a single microcomputer for C.A.I. use may find that administrative use makes more sense at this time. Some programs are beginning to be marketed for administrative uses of Radio Shack and Apple computers with disk storage systems, but I am unfamiliar with their performance.

Another administrative function, the recording and use of student test performance records, relates to the instructional use of microcomputers. Machine-recorded standardized achievement tests are used in most school systems to summarize student performance in basic skills and certain applied academic skills. These tests are used mainly to compare the performance of groups of students, to assign individual pupils to classes the following school year, and to identify children who need special instruction. However, most of these tests can be used to designate which particular skill-learning tasks should be targeted for the instruction of particular students.

Using tests to individualize instructional efforts keyed to identified skill deficiencies is not a common school practice. It requires organizational planning by the teacher, but much research has suggested that this strategy has merit. Microcomputers can be functional appendages to a system that uses test results to select individualized instructional tasks. They can provide individualized testing where the student receives the problems and enters his or her responses at the computer, or they can analyze the answers from paper-and-pencil tests and select subsequent instructional tasks. The former mode is often included with computerized drill-and-practice programs. The "management" functions of such programs give the teacher a summary of student performance and maintain records within the computer so students are given appropriate individualized drills the next time they "log-on" to the computer.

The microcomputer can also be used to manage instruction independently of how students practice their language or math skills. Optical mark-sense scanning machines can be interfaced to microcomputers to provide off-line scoring of answers to individualized worksheet drills which all students can be completing simultaneously. The results can be entered into the microcomputer by way of the optical scanner and analyzed as above. The main advantage of this method of providing individualized stimuli and feedback is that a single computer can accomplish the management for an entire school. The disadvantage is that this application is limited to use with multiple-choice formats, because the scanners can determine the location of marks, but cannot read actual answers. For tests using open-ended numerical or short-answer verbal responses, either the students or a clerical assistant could type the student responses into the microcomputer, which would then continue as above. This procedure is more time-consuming than using a scanner, but it can be used with any type of individualized drills regardless of their answer format.

Few schools use microcomputers to manage instruction independent of a computer-based drill-and-practice program. Several publishers do offer computer programs for test answer entry and scoring. However, I am unaware of any product on the market which includes paper-and-pencil skill worksheets as well as a computer program for entry of student responses, maintenance of student performance history records, and individualized selection of the next sequential learning task. However, given the much more limited computer hardware requirements of this type of drill-and-practice system in comparison to student hands-on C.A.I., I would expect developments in this direction soon.

SIMULATION, MODEL-BUILDING, AND PROBLEM-SOLVING

Drill-and-practice and computer-based tutorials dominate most discussions of instructional uses of the computer primarily because they promise to help educators perform functions which have become central elements in the school curriculum—teaching computational procedures in arithmetic and teaching the components and pieces of written English. Another reason, as we have suggested, is that these learning activities are more easily modeled on the computer than are other aspects of the school curriculum. Thus, computer-based products for schools tend to be developed to address those learning activities rather than to address some others for which computer applications may, in fact, be more suited.

Licklider (1979) suggests that it is easier for "stupid people" to write factual programs (math drill, multiple choice tutorials) than to write programs that help students understand concepts or perform inductive or deductive logic. It is also easier, he says, to treat people uniformly than to respond to individual learning needs, capacities, and so on. Thus, says Licklider, "a large part of the ... dangers in the application of information technology to education is related to the fact that what is easiest and most profitable to do is, by and large, not at all what should be done in the broadest interest of the society and mankind." It is important, he says, to "exploit" opportunities offered by technology without letting organizations responding to narrower interests "exploit" people's wishful thinking about how technology can be used.

Licklider feels that efforts should be directed toward long-range developmental studies on using computers to foster discovery and the ability to organize ideas, rather than trying to use present inexpensive equipment for the more mundane applications like computer-managed-instruction, drill-and-practice, and question-and-answer tutorials (Licklider, 1979).

Licklider's statement is a reminder that disagreements about the kinds of classroom activities that computers should encourage can easily become a debate about basic educational philosophy. One view favors such practices as clear behavioral objectives, authoritative explanation of concepts and processes, and a great deal of practice on well-chosen exercises. The other perspective asserts that learning a subject thoroughly involves intrinsically motivated activity and internal control over problem selection and method of attack. People's interests in how computers could be and should be used in school seem to parallel their basic theory of how learning best occurs.

This contrast between educational philosophies need not necessarily translate into parallel attitudes towards drill, simulation, or other uses of the computer. Tutorials or drills can be developed that provide intrinsically motivated activity, student choice, and exploration of the computing environment. However, such development requires a more systematic effort than usually occurs in the rush to be the first to market a particular kind of product. At the same time, laboratory simulation programs can vary from prepackaged "cookbook" curricula to those that allow unanticipated variations in parameters and even changes in the basic model being simulated—all at the option of the student.

Simulations

Simulations and games became popular instructional tools in the late 1960's and early 1970's. Because they require active engagement on the part of students, simulations were considered to be a motivating and enjoyable way to teach facts and concepts. And, because most simulations are close substitutes for actual experience, simulations were seen as particularly useful for teaching about dynamic real-world systems including concrete historical situations, the operation of economic enterprises, and social conflict. Additionally, simulations, like motion pictures, can be used to engage students for further study on a topic. A particularly well-written computer simulation that has been used in this way is "Oregon Trail," a simulation of a family's covered wagon journey to the West in 1847. Written originally as part of Minnesota's statewide library of educational computing materials, the program has been adapted to run on a variety of microcomputers.

Simulations are usually distinguished from role-playing games in that they have an explicit set of rules, participants are provided with explicit amounts and types of resources, and, usually, preordained goals and a measure of success in meeting those goals. The explicitness of simulations limits the variety of events that are considered legitimate (within the game) compared to more fluid role-playing games. However, the players' permissable alternative actions are meant to reflect the actual alternatives available in the real world.

Most simulations produced for elementary and secondary classrooms do not involve the computer, although many could profit from at least incidental use of the computer for arithmetic computation and distribution of information to participants. Nevertheless, many of the advantages and disadvantages of using non-computer-based simulation activities in classrooms apply as well to computerized simulations.

Simulations, like other organizational forms for instruction such as team competition and peer tutoring, usually demand that classroom authority be, at least, temporarily distributed more widely than usual and that multiple activities be allowed to occur simultaneously. Much of the resistance against using simulations may come from the organizational problems that many teachers believe simulations create. Also, however, research on the learning consequences of simulations has not been uniformly positive. Most studies have found no learning advantages, although student attitudes have shown improvement.

In developing simulations, one design question concerns how complex to make them. The more complex the simulation, the more difficult it is to accomplish learning objectives because the student becomes increasingly unable to isolate the consequences of any given action when so much else is taking place. Elder (1973) suggests employing "progressively developing simulations," simulations either built up by step-by-step accumulation of greater complexity or composed of segmented subsets of problem variables.

There are two basic organizational forms in which computer-based simulations can be used for classroom instruction. Like tutorial and drill uses of the computer, computer simulations can be one-on-one, with each computer terminal controlled by a single student. This structure overcomes objections to the decentralized focus of classroom attention. On the other hand, computer simulations are one application of computer technology in the classroom that does not require that each computer be used by only a single student at one time. Simulations may provide the focus of attention, and be the rule giver, the scorekeeper, and the playing board for an activity that involves many students. In this respect, simulations are a more practical instructional application of computers in classrooms that have a limited number of computer stations.

Simulations may provide students with insights into things that would otherwise be beyond their experience. However, to produce accurate understandings, the simulation model must correspond closely to real-world conditions. Thus, simulation models must specify their boundaries, which limits the extent of discovery available to students. In contrast, actual scientific activity allows the model itself to be subject to inquiry and change.

Model-Building

Constructing or modifying a simulation model is called model building. In model building, a student is asked to specify basic aspects of the model and to judge how well the system corresponds to the real world. In simulations, the model is already formed, and the student uses the model to discover what the system predicts under a given set of initial conditions. Usually the student is asked to assume that the model represented by the simulation is an accurate reflection of the real world (Luehrmann, 1977).

In mathematics and in language, students are often taught "rules" to follow. ("If the numbers when added together total 10 or more, carry the left digit to the next column and record the right digit under the summation.") Rarely are they taught to discover the rule that governs a set of procedures—that is, to build models. Yet this inductive learning may be particularly important for retention of information and for a deeper knowledge of the rule itself.

The computer provides a good vehicle for teaching rule discovery. Rules of a system may be made variously simple or complex; they can be modified to challenge students as they become more skilled; and they may take on a variety of different forms to become more challenging still.

An example of a model-building exercise that has been written as a computer program is called Game X. Game X is a person-against-computer game like checkers, but the player is not told the complete set of legitimate moves. He must determine these from the kinds of moves the computer initiates or makes in response to his own moves. The player can also observe the computer's moves to learn optimal strategies (Goldberg, 1979). This is a general model-building exercise, but more subject-bound examples have been developed.

Simulations and model-building may be advanced and complex tools for use in elementary and secondary schools, but computer programs can be used to help students discover principles and processes on very simple levels—simpler and more concrete than the Game X example discussed above. In this mode, the computer may demonstrate to the whole class or tutor a single student or a small group of students.

Consider the example of using a computer program to demonstrate the isomorphism between graphs and charts and the relationship of both to quantities of objects having different characteristics. A program might display alternative representations of the quantities and also enable the student to modify quantities and observe how this affects their representations as a chart and as a graph (Goldberg, 1979).

As another example, geometric rules can be observed by dynamically changing one aspect of a geometric figure to see how other aspects change or remain constant; i.e., the lines connecting the midpoints of adjacent sides of any quadrilateral always form a parallelogram. The computer could be used to dynamically demonstrate principles and concepts such as these in many ways.

Unfortunately, few programs for using simulated models or for building and testing alternative models have been developed for the microcomputers that schools are now buying. Fewer still have sufficient supporting textual material to integrate computer-based activities with a larger teaching unit on a given topic.

The exploitation of the computer's ability to demonstrate consequences of changed conditions and assumptions will require creative effort. We have too few examples of computer-based instructional simulations to reliably judge the value of this approach. Teachers interested in expanding higher-level inferential skills of students need to be exposed to computer-based simulations, so they can contribute ideas and models for new simulations. Only with a sufficient range and variety of examples will we learn whether computer simulations and model building are practical methods for providing instruction for various subject-matters and grade levels.

CURRICULUM-MODIFYING APPLICATIONS OF MICROCOMPUTERS

Simulations and model-building, although removed in most implementations from lock-step instruction and rote learning, are still primarily viewed as methods of teaching math, language, science, social studies and other traditional academic subjects. Other uses of microcomputers in a classroom, though, imply indefinite changes in the school curriculum. That is, such uses concern not only how children should be taught but also what they should be taught.

The argument for such uses goes something like this: Because the purpose of schooling is to prepare students for the world after schooling, instruction should relate to intellectual activities that will be predominant in society a decade or so ahead. For example, interpersonal communication is increasingly written rather than verbal, and is also increasingly based on typed or machine-retrievable printed text rather than handwritten text. In addition, keyboard communication will be for the forseeable future the primary means of man-machine communication as well. Thus, the teaching of typing skills may be reasonably regarded as a basic academic skill that should be learned as early as such skills become useful in the context of education or extracurricular life.

One of the major outcomes of knowing how to type is an increased capacity to take advantage of computer-assisted instruction. Almost all communication with desktop computers in the immediate future will be through keyboards and video displays; thus the more rapidly and effortlessly that students can translate what they want to say to the computer into machine-readable communication, the more effective will be the time spent at the computer station. Several of those who have studied how computers have been used in schools have reported that a major obstacle to their effective use has been the students' relative unfamiliarity with using typewriter-like keyboards for written expression (e.g., Holzman and Glaser, 1977).

Where once the computer was the expensive tool of space science and Fortune 500 corporation financial management, computers and computer-based telecommunications are becoming a part of most white collar jobs and entering the realm of private residential consumption. The computer will be used in these new settings to prepare text for communication and to selectively retrieve information based on individually chosen criteria. Given the speed of advance in computer and communication capabilities, it may be that the major impediment to widespread use of computers in everyday business and personal lives five years from now will be that too few people will have had enough exposure and experience to effectively use this tool.

Anyone faced with a new appliance, whether a food processor or an automobile, needs to be taught how to use it effectively. However, prior preparation in using a similar appliance lowers both the emotional threshold and the cognitive demands required to master the new one. Just as library skills are considered to be a basic subject in the secondary school curriculum today, so might we consider such skills as learning to compose and edit text and learning to manipulate a large data base to retrieve particular pieces of information.

Development of prototype curricula in these areas should be a priority in education today.

COMPUTER PROGRAMMING IN THE SCHOOL CURRICULUM

Teaching typing, text-editing, and information retrieval are examples of curriculum changes in which the computer is treated as a tool or appliance—uninteresting in its own right, but valuable for the information it helps process. Such uses are not qualitatively different from using the computer to drill students in basic math and language skills. In one view, this is the primary way that computers should be regarded in schools—as tools. An official of Science Research Associates, a company that distributes computer hardware and software to schools, has suggested that microcomputers will have succeeded in schools when they cease to become interesting in their own right—when they become "invisible," so to speak.

An opposing view is that microcomputers deserve to be treated differently from most educational tools. Because computers can serve such a variety of intellectual functions, there is great social utility in helping many students become skilled computer programmers. This viewpoint has been most effectively stated by Arthur Luehrmann, a pioneer in educational computing, in his paper, "Should the Computer Teach the Student, or Vice-Versa?" (Luehrmann, 1972).

In this paper, Luehrmann tells a parable about a society which passed along information solely by oral means. He relates the sequence of events which transpired in that society upon the invention of reading and writing. The new technology was first used in business and government, where the capacities to read and write were most easily translatable into economic profit. Eventually, however, the "vendors of reading and writing" looked to education as a new market to explore. They developed a system where scribes wrote down the words of master teachers, and then professional readers read these writings to students, at a cost far lower than when solely master teachers were employed.

As Luehrmann describes it, this was the "sad ending." However, he provides an alternate ending in which small groups of isolated master teachers began trying to understand the new reading/writing technology themselves and a few tried to teach it to their students. Their philosophical rationale was that 'reading and writing constitute a new and fundamental intellectual resource. To use that resource as a mere delivery system for instruction, but not to give a student instruction in how he might use the resource himself, was the chief failure of the W.A.I. (writing-assisted-instruction) effort,' they said. 'What a loss of opportunity,' they exclaimed, 'if the skill of reading and writing were to be harnessed for the purpose of turning out masses of students who were unable to read and write!'" In Luehrmann's "happy ending," this new skill gradually became more and more acceptable, even to school administrators, some of whom "became competent and imaginative users of the skill (themselves)" (Luehrmann, 1972).

On a less philosophical plane, Hunt and DuBoulay (1979) suggest two rationales for teaching children to program computers. The first is that "construction of computer programs can bring insight into specific aspects of the subject being investigated, especially those aspects concerned with processes." Lipson suggests, similarly, that a useful programming exercise is to have a student write a program that teaches a subject to other students. As with peer tutoring, teaching by writing a computer program helps clarify the subject in the "teacher's" mind (Lipson, 1980).

Hunt and DuBoulay's second rationale for teaching programming to children is that it "encourages them to develop their ability to formulate precise descriptions of how problems should be tackled." In other words, it "brings problem-formulating and problem-solving skills together in a single context." Bell (1976) notes that programming usually produces actions that are part of good problem solving procedures—for example, restating a general problem in a way that procedures for solving the problem can be operationalized. Also, good programming practice includes testing one's solution with a variety of "inputs" to be sure that a general solution was obtained. Frequently, a programmer will want to generalize the program to make the solution apply to a wider class of problems.

A similar rationale is given by Papert (1981). Programming always requires "debugging" because our initial understanding of a problem is usually incorrect or too imprecise to be correctly articulated on the first try. Papert argues that learning to debug computer programs is a valuable skill that generalizes to attacking other conceptual problems.

Nevertheless, the generalizability of programming skills is still a question that lacks strong empirical evidence, and in at least one instance, programming did not improve other applications of inferential skill (Statz, 1973, cited in Howe and DuBoulay, 1979).

Others believe that, regardless of the tie between computer programming activities, problem formulation and problem-solving skills, it is too difficult to teach most people how to formulate precise representations of problems so they could use programming skills to solve them. People's literacy levels in most subjects appropriate to computer algorithmization may be too low to permit the utility of computer programming to be realized (Osborne, 1977). Of course, if this is true of the general adult population, it is probably true of teachers as well; and if true of teachers, could it be less true of students?

Numerous other reasons, though, have been given for including programming in the school curriculum. Programming involves manipulating a concrete object—the computer keyboard—which is an important mode of learning, particularly for younger children. Programming interactive computers is, in many ways, a self-teaching operation. It involves engagement with an immediately responsive environment—one gets rapid feedback about the correctness of one's assumptions—and as such it is motivating intellectual activity. Programming allows for exploratory behavior in an environment with clear boundaries—thus it allows students to exercise a degree of authority which they generally lack; at the same time there is a clear focus and goal to target student attention. Finally, the societal demand for people with programming skills will continue to grow, regardless of the growth of "program-writing programs." Although there will be automation and standardization in computer software, the number and variety of computer applications and the customization required for individual circumstances will continue to increase.

Still, the question remains whether programming is a viable subject for the pre-collegiate curriculum. Of all academic subjects, mathematics most closely parallels the mental activities of computer programming--but a great many people have difficulty learning mathematics. Thus Osborne (1977) could be correct--too few people have the skills required to formulate problems in a sufficiently rigorous way to write computer programs successfully.

An M.I.T. mathematician, Seymour Papert, offers an opposite notion: people's innate mathematical abilities are not too weak, but the way people have been taught mathematics is at fault. Papert feels that teaching programming--in a way that focuses on solving problems using an easily understood computer language--is a primary mechanism for correcting mathematical illiteracy.

"The belief that only a few people are mathematically minded is a truism in our culture and a cornerstone of our educational system. It is, therefore, sobering to reflect on the flimsiness of our reasons for believing it. In fact, the only evidence is crass empiricism: look around and you will see that most people are very poor at mathematics. But look around and see how poor most Americans are at speaking French. Does anyone draw the conclusion that most Americans are 'not French-minded?'--that they are not capable of learning French? Of course not! We all know that these same people would have learned to speak French perfectly well had they grown up in France. If there is any question of lack of aptitude, the aptitude they lack is not for French, as such, but for learning French in schools.

"Could the same be true of mathematics? Could there be a place, a 'mathland,' which is to mathematics as France is to French, where children would learn to speak mathematics as easily and as successfully as they learn to speak their native dialect?" (Papert, 1980).

Papert believes that the answer is "yes." However, he does not think that improved mathematical literacy will result from students gaining experience in programming the currently popular microcomputers. Papert--and others--feel that BASIC, the standard programming language of most microcomputers, is not particularly useful for developing mathematical understanding.

Programming in "BASIC"

Teaching programming using BASIC has a number of problems. Although it is easier to learn to write short BASIC programs than to learn to write simple programs in most other computer languages, complex BASIC programs are not easily understood by others, nor even by the program's author after a lapse in time. This makes them difficult to correct or modify and difficult to learn from. Also, BASIC does not encourage "modular" programming--dividing logical tasks into small, workable subtasks which, like customized building blocks, can be combined in different ways as the need for their function arises. Thirdly, BASIC does not allow manipulating aggregates of data but only individual elements; therefore, higher-order processes must be subordinated to particular details. Finally, like most current programming languages, BASIC does not allow easy simulation of simultaneous activity by different objects. It is a sequential, procedural language.

To overcome these disadvantages, computer scientists at Papert's M.I.T. lab, at the Xerox Palo Alto Research Center, and at other places are developing programming languages which are more easily taught to children and adolescents and which could produce greater mathematical fluency in a wider range of students. These languages, such as Papert's LOGO and Xerox's Smalltalk, do seem to be more appropriate for teaching, although few people outside of the development laboratories have used them in classroom situations.

LOGO and Smalltalk will become available for use in consumer devices over the next several years. However, because they require more computer hardware capabilities than languages such as BASIC, it is likely to be some time until low-priced computers include these languages as integral components. For the foreseeable future, teaching students to program will continue to mean using BASIC.

BASIC does have advantages. Although major conceptual breakthroughs in mathematical understanding may be elusive and programming large problems in BASIC may be unwieldy, learning simple programming logic with BASIC is quite easy. Compared to other current programming languages, BASIC has much of the flexibility and immediate responsiveness of spoken language, which makes it attractive for teaching children (Luehrmann, 1981).

Also, BASIC has been implemented on a variety of small computers in dialects that are similar to each other. Thus, the knowledge gained is reasonably transportable. The diffusion of programming skills in teachers can be more easily accomplished than if different teachers were taught different programming languages. Because it can be implemented on computers with limited capabilities, BASIC is likely to remain a standard in education—where the dollar expense for hardware is a prime criterion.

Thus, in spite of theoretical advantages of languages that are more structured or that enable greater growth of conceptual understanding, BASIC's practical advantages make it likely to remain the single option open to schools that are considering adding computer programming to their curriculum.

How and When?

How and when should programming be taught in schools? Many who have worked closely with small groups of children in rather special circumstances believe that children in grades K to 4 can learn rudimentary programming operations, particularly in special languages likes LOGO in which almost all operations are built up from a few primitive operations. However, programming does require some abstract thought, and most people have assumed that elementary school children lack both an interest in and a capacity for the mental gymnastics involved.

Kay (1977) notes a general improvement at about age 11 or 12 in a child's ability to "plan general structures and to devise comprehensive computer tools." And, in one report, 11-year-old children were able to write their own C.A.I drills and instructional games, but only after a good deal of effort by the instructor to provide examples of the kinds of things the computer could do. When asked to develop a long program incorporating most of the progamming instructions learned through short exercises, the children needed a lot of guidance (Holzman and Glaser, 1977).

Students in grades 6 to 8 seem, on the average, sufficiently mature to understand the abstractions involved in programming. They are less in need of having to manipulate concrete objects in order to understand something. Yet they are still young enough to have largely culture-accepting views of their environment and thus are amenable to exposure to this completely new learning activity.

Older students seem to separate into two groups—a small proportion who are personally interested in programming activities and a larger proportion who view the computer as just another subject in the curriculum. For example, Piele (1979) reported that students in a sixth grade class given an opportunity to learn to program were much more enthusiastic than students at a neighboring high school.

Other factors should influence when to introduce computer programming into the curriculum. First, students should have some typing skills. Particularly if there are few computers; inefficiency at the terminal would interfere with the instruction.

Secondly, among older students, computer programming is more often selected and enjoyed by boys than girls. Although there is no systematic data on this, I would estimate that if we were to divide students into those who show particular interest in learning how to program and those who do not, boys would constitute about one-half of the "interested" group in the first grade, about two-thirds of the "interested" students in the sixth grade, and about four-fifths in the ninth grade. If computer programming is introduced before it becomes socially linked with the male gender, it is likely to reduce the effect of peer and cultural norms on the sex-distribution of eventual programming skills.

Finally, current conditions in schools and in computing must be considered. Although LOGO may be a language which young children can learn, BASIC will remain the most widely available language for many years. Also, because classroom teachers will do the teaching, one must consider the ease of recruiting current teachers into instruction in programming. Most instruction will initially be by secondary school math and science teachers, who have already shown the greatest interest.

These factors indicate that computer programming, along with typing, should be introduced into the curriculum in the first year of middle school or junior high school.

Learning programming requires a mixture of rote learning of programming syntax and semantic knowledge of programming principles taught in a sequence appropriate to the student's prior understanding (Shneiderman, 1977). This suggests a traditional instructional approach: A certain order of topics, skills, and computer language commands is decided upon. Each is introduced for the whole class in the same order. Students practice the same set of lesson-geared examples in order to master the concepts. And concept-introduction, examples, and practice are repeated until each unit of the curriculum guide has been covered.

Watt (1981) believes that programming should follow a different model of teaching—what he calls the "shop class model"—in which the sequence of instructional topics will vary from child to child and no doubt from those of a standard textbook. The teacher's role is to present new material based not only on the prior concepts that the child has learned, but also on the child's goals for using the programming tools. In shop classes, a great diversity of activity occurs because each child works on projects requiring different combinations of tools. So programming should be taught, Watt feels, by allowing each child to pursue an independent programming project and use the programming language as an inventory of tools. Of course, this requires that the teacher know the programming language well and know what kinds of concepts are "do-able" by students at different levels of understanding. Nevertheless, it remains an empirical question whether instruction in programming is better learned using a more individualized sequence of concepts and material than that which is more typically employed in other subject areas. Research should be undertaken to determine empirically what mixture of traditional instructional design and Watt's shop class model is best.

SUMMARY OF EDUCATIONAL APPLICATIONS OF MICROCOMPUTERS

In the previous several sections, we examined the major instructional uses of microcomputers in elementary and secondary schools. We have seen that the most frequently produced computer product—and the easiest to produce—is one that enables the computer to give structured problems to students on an individualized basis, to record student responses for later summarization for teacher review, to provide immediate feedback to students, and to route students to problems requiring greater or lesser skills depending on student performance. These "drill and practice" programs constitute the major offering to date of microcomputers to the basic curriculum of today's schools.

Instructional student-computer dialog which uses the computer to present facts and ideas to students, to evaluate student responses, and to route students to remedial explanations based on an analysis of the pattern of errors extends the drill-and-practice idea. These dialogs or "tutorials" vary from simple exchanges involving relatively little analysis by the computer to complex programs that analyze and diagnose error patterns in student responses. But most involve exchanges of verbal rather than mathematical concepts and suffer from an overly simplistic notion of verbal discourse. These programs tend to be less successful than drills because they are unable to semantically decode a sufficiently wide range of human responses.

Computer-managed-instruction provides a way for the teacher to identify the particular concept deficiencies of individual students. This can accompany computer-based drill and tutorial programs or it can be built into paper-and-pencil learning activities, an alternative which requires fewer computer resources. The latter approach loses any motivational and learning advantages that might be gained from student hands-on contact with a responsive computer program, but it produces informational feedback to the teacher (and student) about precise academic strengths and weaknesses of individual students that can be used to individualize instructional treatments.

Simulations and model-building are computer-related products that may be less broadly applicable than drills and tutorials and which require greater programming effort than most drills and most practical tutorial programs. Nevertheless, they make use of computer capabilities that are difficult to duplicate by other media. In contrast, computerized drills and tutorials merely replace one delivery system with another. Furthermore, as long as computer hardware remains expensive compared to other instructional aids, simulations and examination of models used in a demonstration mode can simultaneously serve much larger numbers of students than those applications requiring one-on-one interaction.

Computers may also be used to extend the curriculum to make schooling more relevant to the cultural requirements and opportunities that students will face in coming decades. The mere presence of the computer illustrates how important typing competence will be, and provides an opportunity to extend instruction in that subject and in allied areas such as computerized information retrieval.

We also discussed the appropriateness of computer programming in the pre-collegiate curriculum. It is my guess that of all the ways in which microcomputers have been used in schools, teaching programming has been the most common and the most successful. (The national survey which we will undertake during the next few months will provide much needed information about computer uses in schools.) However, it is still too early to know all the details about how to teach programming to students--at what grade level, with what prior mathematical understanding, using what types of computer languages, and using what teaching methods.

SOCIAL ORGANIZATION OF COMPUTER USE IN SCHOOLS

Throughout most of this paper we have concentrated on particular instructional uses of computers in schools. Now we turn to issues related to how the use of computers may be organized irrespective of the instructional operations which they may be performing.

Regardless of how capable microcomputers may be for giving students practice with drills, engaging students in a useful dialog, demonstrating the properties of systems through a simulation, or helping students obtain useful keyboarding or programming systems, their theoretical capabilities are irrelevant if they cannot be used effectively by teachers and other school personnel in the ongoing activities of existing educational institutions.

Foremost among the problems to be overcome is the contrast between the capacity of a computer to interact profitably with a single student and the group-based organizational structure of schools. Although schools may vary somewhat from the common pattern, most instruction is provided to students in spacially segregated groups of 25 to 35 students directed by a single adult in an enclosed area. In secondary schools, and often in elementary schools, the composition and location of these groups changes hour by hour as students move on to study different subjects with different teachers.

In this context, three things about microcomputers stand out: First, although microcomputers are relatively compact and portable compared to previous computers, they are still "machines" to which students have only temporary access; second, their predominant mode of use is with a single individual at any one time; and finally, for some time to come they will be costly compared to other classroom learning materials and will be easily outnumbered by students present.

Centralized vs. Classroom Placement

Computers, thus, constitute a limited resource. Schools must decide not only what material students should learn on the computer, but also which students should have access to this resource and how the equipment should be placed within the school. There are three ways that computer equipment might be allocated: (1) distributed to individual classrooms under individual teacher control, more or less indefinitely; (2) housed in a central warehouse facility, as audio-visual equipment is now, but directed to individual classrooms as needed or requested; and (3) located and used in a central facility, such as a math lab room or the school library, under the supervision of a staff member responsible for the activities in that room.

Several factors argue for centralization of placement and authority over use. Given the expense of the hardware, schools naturally desire to maximize the number of minutes of the school day during which each computer is in use. Placing a single individual in charge of computers may produce more efficient use of the equipment than if each teacher tries to oversee use of the machine(s) in her room while also managing instruction for an entire classroom. Also, centralization could allow entire classrooms or classroom groups to receive simultaneous instruction using the computer, leaving teachers free to handle other instruction for individual students or groups of students.

Computers, like typewriters and books, are essentially intellectual environments for the use by a single person at any one time. Classrooms are primarily group interaction systems, often with a single focus of attention for all individuals. The management of individual activities is often best done in a setting, like a laboratory, designed around the idea that everyone is conducting individual activities. In contrast, when a small number of computers are located in a classroom, it becomes difficult to manage group instruction for some children while other children alternate between listening to the teacher's presentation and conducting independent study at a computer.

Centralization is also suggested by concerns over the security and care of the equipment and the expertise required to take advantage of more sophisticated data management opportunities using the computer. However, these points must be regarded as "tendencies," because individual differences in implementation and personnel may be more important than placement of the computer in determining these outcomes.

In addition, there are several good reasons to support the decentralized allocation of computers. First, the most successful uses of computers may be those developed and managed by particular teachers who, for one reason or other, have become experts or enthusiasts for their use. It may be best to leave the computers in the hands of those teachers who have expressed interest in using them, regardless of possible distributive inequities within the school.

Also, centralized allocation may not replace ideosyncratic expertise and enthusiasm with greater efficiency, if it is accompanied by centralized authority over how the computer is used. This may produce a more standardized computer based curriculum and less clear relevancy of computer activities to classroom activities.

Sheingold (1981) observed one instance in which there was an overall relationship between the classroom math work and the computer drills in the resource center, but there was no matching of the exercises performed on the computer and the instruction being given in class. Individual differences tended to be neglected due to the limitations of the computer program and the segregation between the supervision over computer work and observation of the students' performances in the classroom.

Davis, head of the Plato system at the University of Illinois, believes that computing experiences SHOULD be an integral part of the classroom experience, and that the presence of the computer in the classroom will encourage more teachers to become exposed to and experienced with computers.

The choice of how microcomputers are distributed in the school may not be independent of the decisions about their use. Although this proposition needs further empirical elaboration, a strong relationship appears to exist between placement and predominant use (c.f., Sheingold, 1981). Where computers are under the control of classroom teachers--particularly teachers who have some interest in computing themselves--there is likely to be little talk of "improving learning outcomes." Instead, the focus may be on curricular enhancement and exposure to computers as part of general education. In contrast, centralization of computer facilities is often accomplished in schools emphasizing C.A.I. drills, computer-management of individualized drill, and record-keeping. Neverthless, the location/authority question and the function question are still logically independent.

Regardless of where the computer is housed and under whose authority it is placed, attention must be paid to keeping the equipment in use--rather than allowing it to remain idle or in need of repair. This would not normally be a high priority among most teachers, whose orientation is toward managing a classroom of children and covering instructional material in the curriculum. Optimizing the use of expensive equipment is not central to most teachers' concerns; thus, investing school system money on computer equipment almost demands that supervisory personnel be diverted or hired to support teachers using computers and to oversee their use. There are always questions about using equipment and specific programs, modifying programs to fit circumstances, equipment malfunctions, and so on. Depending on the quantity of computer equipment, school systems may want to locate supervisory people in the school buildings or in a central office, or may engage support services on a contract or consultant basis. Kenneth Brumbaugh, who directs the Minnesota Educational Computing Consortium (Minnesota's statewide support service organization), suggests that providing support for teachers using computers in their classroom is as important as providing them with software to use.

Besides One-On-One

Most computer programs written for the classroom market assume that each computer is being used by a single child at any one time. As we have seen, this assumption, when translated into products, severely limits the number of children in most classrooms that can be served by available equipment. The assumption about one-to-one use has origins both in the "programmed self-instruction" historical development of educational applications of computers and in the practical limitations of most current equipment—a small video display screen and a single keyboard. Although the practical limitations are not inherent—imagine, for example, a large video display and several keyboards connected to the same microcomputer—they do affect how most people think about program development for classroom use.

On the other hand, it is clearly possible to develop learning activities, including game-like drills and simulations, that involve pairs or several students simultaneously. In addition to providing an environment in which more children can be occupied in a directed learning activity, such programs would also address the preferences that most children and adolescents have for interpersonal rather than individualized learning situations. Writing programs that are interpersonally interactive as well as person/computer interactive certainly requires more creativity than writing drills. However, for now, they may be more functional for typical classroom learning environments. The programs could involve students challenging one another with problems for which the computer is judge (regarding issues of "fairness" as well as "right" and "wrong") and official scorer; interactive games in which the computer is the "playing board"; and simulations in which students take on different roles or work together to solve problems.

Social interaction is by far the most common mode of learning in school, and computer programs could build on this fact. Levin (1981) reported on the use of computers by children in an informal educational setting. Despite an abundance of computer equipment and activities designed for individuals, the most common social arrangement observed was groups of children gathered around a single computer working together at a computer-related task, leaving most other machines unoccupied.

Another alternative to individualized and small-group work at the computer is use of the computer for whole-class demonstration purposes. The major drawback here is the size of the computer display. Nevertheless, if single-computer classrooms continue to be prevalent at least in the short run, it would be worthwhile to develop innovative ways to use the computer in a demonstration mode despite the visual difficulties.

Classroom Microcomputers, Home and Other Influences

Schools are not considering the use of microcomputers in the classroom in a cultural vacuum. Their involvement grows out of the same social developments that are affecting other institutions in society, where small computers are increasingly being bought and used. Many students are gaining exposure to microcomputers and microcomputer-based video games outside of school. Presumably, this exposure influences how they respond to assignments to use the computer in particular ways.

Computers, like few other appliances, have a wide variety of uses. Sometimes when an object is used for different purposes, such as a table used for both eating and writing, the mental baggage associated with one use distracts from efficient use of the object in other ways. This is why teachers often suggest that parents set aside a special place in the home for their child to do homework.

The multipurpose nature of computers raises a similar problem for the design of computer environments for classrooms. The computers that schools buy for their classrooms are sold in the consumer market, often as game-playing machines. The similarity of these computers to electronic video games raises the question of whether these alternate conceptions of use ("I could be playing Space Wars; instead I have to solve these dumb arithmetic problems.") interferes with the implementation of instructional programs on the same equipment.

Will students who are accustomed to interacting with responsive video devices for non-intellectual recreation resist using the computer for drills more than students who have not previously been exposed to any computer use? What about students who have gained some programming skills—will they be less willing to use computers in the classroom as a teaching machine over which they have little control? One is tempted to answer these questions in the affirmative.

However, the effects may not be totally one-sided. Students with prior exposure to similar instruments seem to be less apprehensive about using computers in the first place. And although they may prefer to "play games" on the computer, most children do understand that at school it is often necessary to engage in intrinsically less interesting activities than one would choose on one's own. Program developers writing for a recreational or home market may need to pay more attention to infusing their learning materials with motivators like graphics, color, and game-like environments than do producers of a similar product expected to be used under a teacher's direction.

Some Possible Undesirable Consequences of Computers in Schools

Computer-based learning in schools may also have consequences beyond the subject-matter learning that takes place. A primary concern of teachers (Lichtman, 1979) and C.A.I. researchers (Seltzer, 1971) is that computer-based learning can be isolating and can have deleterious effects on the interpersonal social skills of students. An emphasis on using the computer for individualized drills would certainly make such a hypothesis plausible. Alternatives that we discussed earlier—designing computer-based activities for small groups, using the computer in a classroom demonstration mode, and using networks of interacting computers—would minimize such outcomes as well as make such experiences more enjoyable (Lipson, n.d.).

There are also claims that computer-based experiences leave people intellectually less able than more social experiences. The highly structured, limited discourse permitted by computers may be a poor substitute for discourse that is more broadly knowledgeable, combining reasoned argument about complex ideas informed by information retrieved from human minds rather than stored on magnetic tape. These fears may reflect a general fear that quantitative style will overpower and suppress qualitative aspects of classroom learning (Friedman, 1980).

In addition, computer-based learning environments, using visual, pictorial, and graphic media and often including auditory symbols, suggest a different orientation towards learning than a more traditional emphasis on the written word. A librarian whose establishment has been recently augmented by several computers suggested that although the exposure to computer skills was no doubt beneficial in some ways, she doubted strongly that it would carry over into increased use of the books in her library (Yasaki, 1981).

Whether these more multisensory media increase intellectual skills is still debatable. A recent NYU study found that people who watched the much-praised "Ascent of Man" series on public television could not remember much of the cognitive information that had been conveyed. In contrast, proponents of computer-based learning point to the active nature of work at a computer terminal, as opposed to passive television watching, and suggest that the apparent similarity between computer-centered activities and other technologically advanced media should not be accepted at face value.

Another social issue related to computer use in schools concerns the social distribution of computer-related skills across population subgroups. Private ownership of microcomputers is strongly tied to social class and family values. It has been argued that schools need to have microcomputers in order to reduce the private disparities between children in learning computing skills outside of school. However, to date, it appears that schools that are investing in microcomputers are disproportionately those in the wealthier school districts. A recent market survey shows a penetration of 30% in schools with a very low Title I eligibility rate compared to a penetration rate of 12% in schools with substantial poverty (Market Data Retrieval, 1981). Insofar as microcomputers present vocationally, intellectually, and culturally useful opportunities to students, current patterns of adoption are likely to parallel rather than counterbalance private distributional inequities.

Within each school, similar questions of distribution, access, and types of use arise. Some schools tend to allow only the brightest and most motivated students to use the limited number of microcomputers. In other circumstances, drill-and-practice uses may be channelled to the lower-achieving students in the school, while the better-prepared students use the computer to create programs of their own choosing. This may be "optimal" use of the computer facilities in one sense, but such diversions may exacerbate the variations in attained academic competencies between the initially slow and the initially high-achieving students in the school.

For each of the problems that may result when microcomputers are introduced into the school's ongoing educational structure, systematic research could help discover their incidence and severity and the conditions under which the problem is minimized. However, in the absense of research, those who implement various uses of microcomputers in different educational environments should be aware of these problems and should share with other educators how they deal with them.

FROM REALITIES TO DREAMS FULFILLED—THE NEXT STEPS

This paper has conveyed contrasting feelings. On the one hand, there is the excitement felt by those who perceive the microcomputer to be a harbinger of monumental change in the capacity of information machines to affect the method and content of students' education. On the other hand, there is a strong feeling that applying current microcomputer technology with limited equipment and without forethought about integration with traditional classroom instruction will produce disappointments and poorly utilized resources.

However, although it may not be possible to implement computer-based instruction in every classroom today, many activities can still be undertaken to improve the way that computers affect tomorrow's educational process. A follow-up paper will discuss the major steps that should be taken now by researchers, product developers, and school system personnel. This second paper will treat the following points at greater length.

Researchers

The major contribution of research is information about processes and consequences. The claims made in this paper are based primarily on rational argument, individual observation, and the experiences of "expert witnesses" such as practitioners and developers. For reliable decision-making by schools and by product developers, more systematic information is necessary. We need to develop an unbiased and representative body of information about how schools decide to obtain and use microcomputers and other technological learning tools, how they use them, and the effects that their use has on students and on the social organization of the school.

As a first step in this effort, the Johns Hopkins Center for Social Organization of Schools is surveying about 1,500 public and non-public schools to learn how schools, that are using computers in any one way, differ from those that are using them in other ways, and from those that are not using microcomputers at all. Also, the survey will identify factors that are related to particularly successful implementations of microcomputers—in the sense of maximizing their use and their impact on students and the school. Finally, the survey will provide a more factual basis for many of the suggestions expressed in this paper concerning the problems of social organization faced by schools that are using a limited number of microcomputers in the context of classroom-based group instruction of students.

Something which this survey cannot do, but which should be done by any group implementing computers in their instructional program, is to design the implementation so comparisons can be made between different groups of students and teachers given varying "exposures" to microcomputers. Where possible, these exposures should include randomized assignments to "treatments" so that the effects of self-selection can be reduced.

Developers

Although the quest for financial reimbursement for intellectual productivity is a practical consideration, it is important to encourage longer-term developmental eforts than those that provide immediately usable products. Until such time as schools can buy enough microcomputer equipment so that a given application can be easily implemented in classroom instruction, efforts should go into improving the quality, depth, and comprehensiveness of computer-based materials and their integration with traditional instructional materials.

Specific programming details can be worked out at the end of the development period to conform with the characteristics of widely used microcomputers at that time. In contrast, the logical structures necessary to make particular types of learning possible are largely independent of the particular computer used and partially independent of the content, and thus deserve first consideration. Organization of content comes second; and features particular to the make and brand of the computer used in the classroom come last.

Thus, efforts should be directed toward developing ways for computer programs to provide instructional assistance; developing bodies of instructional content and methods of presentation; and developing algorithms for sequencing instruction, providing feedback and assistance to students, and organizing the information to be provided to the teacher. A rough guideline of "5 years to market" and technological sophistication equal to today's $200,000 multi-user systems should be assumed.

Simultaneously with this long-range development, efforts to create more immediately usable products should focus on how to make a very few microcomputers functional for a classroom of children: activities for several children at one time at one computer, demonstration-mode simulations, computer management of individualized instructional assignments, and development of materials for teaching programming to teachers as well as to students.

Schools

It is important that schools not be unwitting victims of the enthusiasm of amateur computerists or the aggressive marketing of producers of computer-related materials. At the same time, schools should encourage their staff members to become more knowledgeable about using microcomputers and to seriously evaluate their worth for various functions.

School systems should seek to develop computer literacy in as many staff members as possible, particularly among staff librarians and among secondary school teachers in math, science, English, and business. Teachers with strong disinclinations and those with strong inclinations should be excluded or included as they choose. By computer literacy, we mean familiarity with the variety of instruction-related tasks that microcomputers can be expected to have now or in the near future; and experience in using microcomputers for text preparation and editing, test scoring, and packaged instructional programs. For many teachers, computer literacy should also include acquiring the ability to write BASIC language programs on existing microcomputers and to teach programming.

Staff education should include the policy-makers who will have the responsibility for making purchasing decisions. There is the danger, though, that exposure to computers tends to increase the demand for purchases of computer equipment for classroom use, including purchases which may not yet be wise for schools to make. Nevertheless, widespread staff understanding of computers is a prerequisite for policy discussions—whether at central office or building levels—that should precede any decisions to purchase equipment for instructional use.

The policy discussions are essential and should focus on (1) appropriate uses of computers for assisting traditional and newly emergent instructional goals, and (2) organizational issues regarding the computers' use. Wise policy would refrain from making computer purchases until their function and the manner of their use has been clarified and the plan seems plausible considering (1) the availability and quality of any software and other educational materials that are needed; and (2) the constraints of using individually-oriented learning tools in the context of a group-based instructional organization.

Not to preclude other conclusions resulting from such policy discussions, it is my perception that results of this kind of analysis at present would include decisions something like the following:

At a secondary school, a decision is made to defer purchase of currently-marketed microcomputers until the school can afford to purchase at least eight units, each with disk storage and sharing one printer among them (an investment of approximately $12,000), and when one staff member—the initial proponent of obtaining computers—has prepared a curriculum in computer programming that incorporates an approved textbook with an appropriate reading level and that uses a programming language essentially identical to the language used in the machines purchased. Waiting until eight microcomputers could be afforded would ensure that when the class was finally held, it would not be held back by an inadequate ratio of microcomputers to students.

At an elementary school, a hard-headed analysis concludes that microcomputers should not be purchased until at least one of the following activities could be accomplished using off-the-shelf computers, computer programs, and teaching materials:

(1) When, by using an inexpensive set of curriculum-complete workbooks and tests and optically scanned answer sheets feeding into a single microcomputer, the teacher can provide individualized evaluation and individualized sequencing of assignments. The computer programs for analyzing test results must be supplied along with workbooks and answer-recording sheets.

(2) When a variety of computer programs are available to help children explore various capabilities of the computer including sound, color graphics design, and typing and text editing. These are to be used for enrichment exercises for students who have already mastered work for which the remainder of the class requires additional time and teacher attention. This use requires fewer machines, perhaps five or six, centrally located under the direction of a trained staff member such as the librarian. The programs must come with associated teaching materials that provide starting points for student exploration.

(3) When tutoring and remediation in a variety of math and language skills—not simply computer-based drills—can be provided to most of a classroom at one time while the teacher works with small groups of students who have fallen behind the group-paced instruction. Twenty or so individual microcomputers linked for efficient

> information and program storage would be needed as well as a person who is trained in managing such a facility and who is familiar with the curriculum presented on the computers. This investment, most people at this school believe, is unwise for the foreseeable future and unsupported by any set of computer programs on the market.

These are hypothetical policy choices, and many schools will draw different conclusions in essentially the same environment. Microcomputers still have a largely emotional following, and feelings run strong regarding their benefits and their costs. Decisions about their use should be based upon as much information and as much participation as possible.

A Final Word

The advances being made during this decade in the capacity of electronic media to store, retrieve, and process intellectual information at a steadily decreasing cost is one of the more exciting trends in an often-discouraging world. Someday, schools may be able to use the fruits of this technological advance to help children and adolescents attain greater academic competencies and skills than the generations before them. However, it will not help for us to uncritically accept every "computer-based" anything that comes to market. We must think clearly about how we want our children's education to improve, what computers can do to help, how that assistance can, in fact, be accomplished, and whether any of this is affordable. Through appropriate research, well-organized strategies of educational program development, and careful policy-making and staff development by school systems, we may be able to make today's dreams about computers and kids into tomorrow's realities.

FOOTNOTES

1 - These estimates are based on a variety of sources including a survey by the National Center for Education Statistics, surveys by two firms who sell specialized lists of school personnel for marketing products, and discussions by persons in the field. The Center for Social Organization of Schools will be conducting a national survey of schools during 1982 and will be able to provide much more detailed accounting of possession and use of microcomputers in public and private schools by the Fall of 1982.

2 - For example, Brudner (1981) took a census of computer purchases in four states. In a more or less typical state—Oklahoma—he found that in late 1980, 40% of Oklahoma high schools had at least one computer but few elementary schools had any. Most schools had exactly one computer. Very few had more than five. Most were in use in high school math and business education classes.

3 - One non-profit organization, People's Computer Company, received federal funding to install computers in the public libraries of a municipality and to develop activities, such as a parent-child programming course, that bring computer literacy to an entire population. However, it is not insignificant that the community selected for this demonstration is one of the wealthiest, most computer-literate, suburban areas in the U.S., located adjacent to Stanford University and one of the major centers of microcomputer development.

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MICROCOMPUTERS IN THE CLASSROOM:

Are There Unique Issues for Vocational Educators to Consider?

By
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The role of the microcomputer in education is frequently discussed and studied by educational researchers, curriculum specialists and those who define and develop theories on teaching and learning. The unique issues which confront the vocational educator, however, are not often addressed. This trend towards intermixing the needs of general educators and vocational educators continues to be pervasive in the literature which discusses the role of the microcomputer within instruction. What is sacrificed in that process is attention to the unique needs of vocational educators.

The previous chapter by Becker examines theoretical and practical issues to consider when using the microcomputer as an instructional tool. This chapter will focus on the unique role of the microcomputer as an instructional tool within vocational education and in so doing, will focus on key concerns of the vocational educator.

Introduction

When discussing the integration of computers into instruction, it is not only important to focus on subject matter and appropriate classroom activities but also on simple logistical procedures such as transitions between computer and non-computer activities, grouping strategies, matching courseware to instructional goals, the structure of the subject matter, etc. The focus needs to be not only on the use of microcomputers for learning activities within an established curriculum, but also on the adaptation of the curriculum so that new pieces of software can be effectively integrated into a curriculum.

Microcomputers & Competency-Based Education

For vocational educators, more often than not, this involves integrating computer-based education into a curriculum which is competency-based. "Competency-based education" is instruction which emphasizes student mastery of specific skills or competencies. Instruction can be in a traditional classroom or individualized, with students progressing at their own rate. By definition, a "competency-based" program specifies objectives (competencies) explicitly, identifies the criteria to assess the learner's mastery of the competency, and holds the learner accountable for meeting the competencies. According to Calhoun and Finch (1976), two major technologies must be in place in order for competency-based education to function effectively within a traditional educational setting. The first is a modularized instructional program. This means that instruction, individualized (i.e., individual learners proceed through the competencies at their own pace) or taught to a group of students, must be structured around a curriculum in the form of learning modules, thus allowing for group or self-paced instruction and testing. Modules are constructed so that individual students or groups can interact with the content, proceed at their own pace, use the available print resources, audiovisual aids and laboratory equipment as required and, at the same time, receive the immediate assistance of the instructor when difficulties arise.

The second major technology necessary for the implementation of competency-based education is a management component through which the competencies, whether taught in a group or self-paced format, can be monitored, controlled and evaluated.

Evaluation is different in a competency-based curriculum. Demonstration of competencies replaces traditional class grades (structured on a constant time allotment). In a competency-based program, the time element varies depending on the capabilities of the individual learner, but the competencies which need to be completed in order to achieve mastery are clear and consistent across learners, i.e., all competencies must be mastered in order to proceed through the curriculum or complete the program of instruction.

Not only does competency-based education allow students to pursue their education at their own pace and interest level, but it is also particularly suited to the open-entry/open-exit policies which permit a student to enter and complete training without the restrictions of the traditional calendar year.

In summary, the guidelines and goals which direct a competency-based curriculum are:

- let learners know what to expect,
- measure the learner's performance at the end of each segment of instruction,
- show learners what skills or information will be learned,
- provide opportunities for learners to practice skills,
- provide alternative learning strategies,
- provide open-entry to and open-exit from courses, and
- use the results from the program to improve instruction.

(Ofiesh, 1984)

Applying these guidelines and goals might result in a list of performance objectives (competencies) such as the following which were developed for a course on microprocessors. These particular objectives lend themselves to individualized competency-based learning.

1. Given wood side panels and finishing materials, the student will finish side panels. Performance will be satisfactory if: A) Wood sides sanded; B) Wood stained; C) Two coats of varnish applied; D) Sides steel wooled; and E) Sealing oil rubbed in.

2. Given metal chassis, keyboard plate, and metal working equipment, the student will fabricate chassis and keyboard plate. Performance will be satisfactory if: A) Keyboard plate cut per drawing 1; B) Chassis cut per drawing 1-B, C; and C) All holes deburred.

3. Given cut chassis and keyboard plate and finishing materials, the student will paint metal chassis and keyboard plates. Performance will be satisfactory if: A) All surface blemishes removed; B) Surfaces cleaned and prepared for paint; C) Primer coat applied; D) Two coats of color applied; E) Paint dried to hard finish; and F) Decals applied.

4. Given painted chassis, keyboard plate, cover plate, stained wood sides and hardware, the student will assemble chassis, keyboard and side panels. Performance will be satisfactory if: A) Sides securely attached to chassis; B) Piano hinge attached to chassis and keyboard plate; C) Plexiglass cover trimmed and set in place; D) Instructor inputs and approves the chassis and keyboard and signs Lab 1 sign-off sheet; and E) Student turns Lab 1 sheet into instructor.

5. Given video board components, the student will solder components to video board. Performance will be satisfactory if: A) Components mounted according to accompanying instructions; and B) All joints soldered properly.

6. Given soldered video board, the student will solder option jumpers. Performance will be satisfactory if: A) Option jumpers are installed as per page 2-37; and B) All joints soldered properly.

7. Given completed video board, the student will connect video board to "character generator jig." Performance will be satisfactory if: A) +8, ground & -16 volt lines connected; B) Composite video output to video monitor;

C) ASCII keyboard unit properly to J1 on video board; and D) Temporary connector has been added to J2 pins 2 & 3 on video board.

8. Given video board completed, the student will operate video board. Performance will be satisfactory if: A) Monitor displays "clean" video; and B) Full character and cursor control is achieved.
(Rodenstein, 1984)

What can the microcomputer do to enhance instruction in the type of curriculum described above—a competency-based curriculum? To begin, let's examine the major guidelines which have been established to define quality software used in computer-based education. These include:

- Gaining the student's attention
- Informing the learner of the objectives of the instructional module
- Stimulating recall and assessing prior learning
- Presenting learning stimuli to teach concepts and facts
- Guiding learning
- Eliciting performance
- Providing informative feedback
- Assessing/evaluating performance
- Enhancing retention and learning transfer

(Gagne, Wagner, and Rojas, 1981)

It appears that the characteristics of quality software are those which are also the foundation of a competency-based curriculum. The list of goals for "computer-based" instruction and "competency-based" instruction are quite similar.

Not only can the modular individualized format of instruction in a competency-based curriculum be easily adapted to computer-based education but, in addition, the microcomputer can also be used to enhance instruction of competencies in a large group setting. An example of such a technology application is the IVAN system, which stands for The Interactive Video Access Network. With this type of network, the instructor can use controls to monitor student computer activity in an unobtrusive manner, interact with the student through the monitor without moving from the teaching station, place the contents of the instructor's monitor, or any student's monitor on a 25" video monitor to encourage classroom involvement and suspend personal computer activity during lectures to control and/or direct student attention to the instructor or alternative instruction resource.

In summarizing the parallels between the competency-based curriculum commonly used in vocational education and the instructional programs that can be provided by quality software via a microcomputer, it is clear that the two sets of goals appear to fit together from the initial step of providing information to the learner regarding the content of instruction, through the presentation of instruction, until learning is assessed. The flexibility and individually-paced nature of computer-based learning seem to go hand-in-hand with the competency-based instruction of many vocational education programs.

Computer-Managed Instruction

Not only can the modularized structures of competency-based education be enhanced by computer-based instruction but the management of instruction, another major component of competency-based education, can be improved with the microcomputer. Through the management component, the academic progress of each student can be monitored, controlled, and evaluated. Good software provides a component which keeps track of student progress and student time on task.

This component is often referred to as Computer-Managed Instruction (CMI). Although not originally designed for the competency-based curriculum, the assumptions on which it is based are also the foundation of competency-based education. According to Baker (1978) they are:

1) Mastery Learning- This type of learning assumes several things. First, the curriculum can be divided into smaller units, each then broken down into measurable student objectives. Second, student progress can be measured such as on a quiz, test or completing a project. Subsequent teaching is based on the student's performance throughout the instructional units. Third, all students can eventually master the competencies and fourth, mastery learning identifies the minimum that a student needs to learn to understand any given concept. Student progress on objectives is measured as the students move through the curriculum at an individualized pace. The teacher first identifies the objective, the acceptable level of learning, and an assessment tool which will indicate when that level is reached.

2) Individualization - Students have the opportunity to learn at their own rates of progress. Because students differ in their progress, they can receive instruction commensurate with their learning style, interests and needs. This leads to different goals within a curriculum, alternative paths through the curriculum, varying instructional methods and varying rates of progress with the same curriculum.

3) Teacher as Manager - A major assumption of CMI, along with competency-based education, is that the instruction needs to be managed. With CMI, the computer can do the the managing. For example, the computer can keep track of student progress so that the teacher can analyze the data and develop new instructional activities to enhance the instruction. The information can be used to diagnose special needs and prescribe learning activities for those students.

For example, a computer-based program developed to train auto mechanics in the mechanical innovations of the new model cars, is structured in short modules or clusters and can be used when a student needs to master the competency taught in that particular module. Instructors, with the management component, can keep track of which student has used each module and the scores on the quiz at the end of each module. The modules are used on an individualized, self-paced basis so that not only can the teacher monitor student activities but s/he can also provide remedial work to a student by reassigning a module when the content has presented a problem for the student.

In understanding the relationship between CMI and your own responsibilities as an instructor in a competency-based program, Patterson and Patterson (1983) suggest that educators ask the following questions:

- Does the philosophy of the instructional program match the philosophy underlying CMI?

  The assumptions are one and the same: mastery learning individualized instruction and the teacher as instructor and manager.

- Is the curriculum structure organized sequentially?

  The assumptions of CMI, along with the assumptions of a competency-based curriculum, are that each unit of instruction serves as a stepping stone to higher levels of learnings. A roadmap of instruction is important to define goals and measure achievement of those instructional goals.

- Is the instructional cycle defined sequentially?

  The answer again is, for a well-designed competency-based curriculum, yes. A curricuium needs to first assess what the student knows, prescribe the appropriate learning modules and monitor progress so that all defined competencies are mastered.

- Do your instructional management needs require computer support?

  This question brings up another issue. Although it is clear that CMI does fit together well with a competency-

> based curriculum on paper, in the classroom instruction and evaluation might be based more on observation, personal judgment, and evaluations from outside employers. If so, the management tasks, although they can be handled by the computer, might be more cumbersome than a more traditional method of collecting, sorting, analyzing and reporting data for each student.

Each individual teacher's needs also vary in the amount of convenience that the computer can provide in the area of instruction and management within a competency-based curriculum. Many teachers will only use the microcomputer for drill and practice of a concept which has been taught in a more traditional fashion (often refered to as "adjunct CAI"). Some instructors will use a management system to monitor activities, while others will use the computer as a tutorial to teach new concepts and offer supplementary instruction for those who have trouble moving through the modules. Still others will use the microcomputer only to monitor and manage a competency-based curriculum.

Whatever route an instructor takes, it is useful to explore the many ways and the degrees to which CAI and CMI fit into a competency-based curriculum. They appear to be systems which were "made for each other."

Theoretically, there appears to be a strong connection between the capabilities of a microcomputer and the tasks within a competency-based curriculum. This publication contains profiles of schools and examples of curriculum which have integrated microcomputers into the curriculum either as an instructional or management tools. Other programs which are utilizing microcomputers in unique ways will now be highlighted so that the application of the above-stated theories becomes practical and useable.

Innovative Applications

Interactive Videodiscs

Two capabilities of the microcomputer which have not been developed to date, but hold much promise for vocational educators, are the ability of the computer to interact with the learner, and the individualization of computer-based instruction. The concept of "interaction" can be defined by the description of a program written by Alfred Bork at the University of California-Irvine. The program is on batteries and bulbs. The objective of the program is to place the student in the role of a scientist who has to make a decision. The students begin by making observations and gathering evidence (background work which leads to a decision). The student is protected from floundering around for too long a time because the program is designed so that the student is tested as s/he progresses although unaware of the testing situation. The results of this "subtle testing" are used by the program to further direct learning activities.

The initial task is to light a bulb. Initially, the student receives no guidance from the computer but is allowed to try anything. The computer, however, is noting what the students are doing and eventually offers tutorial aid. By the end of the first module, each student has lit the light bulb by two different methods.

During the next seven modules, the user builds a model of "what happens in electrical circuits" which is based on the empirical evidence gathered during the experiments. After the model is developed, instruction shifts to experimenting with predictions based upon the model. The user is thus interacting actively with the computer; a far cry from reading a textbook or listening to a lecture. The program not only defines the concept of "interaction," but also the concept of "individualization." Each student gathers data and develops a model at his/her own pace, although all will eventually achieve the same learning objective.

Bork stresses that the "quality" of the interaction and individualization are important factors. Interactions and individualizing can differ in frequency, quality of interaction, the way the analysis takes place after data input and the effect of student input on the progression of the instruction.

Currently interactivity and individualization of computer-based instruction is being enhanced through interactive videodiscs and/or videotapes. With this type of system, the microcomputer is being used to index and control video frames. By using the computer to control a video presentation, there is greater flexibility and enhanced power in deciding how and when material will be presented, the student may skip, repeat, stop or slow down a presentation making the pacing of material very different from normal real-time video presentations.

Again, for vocational educators who work within a competency-based curriculum, this type of system offers learners an open-entry/open-exit opportunity to pace themselves through a competency-based individualized program and to receive personalized training in skills which need to be mastered.

The hardware in this type of system typically includes a computer such as an Apple IIe interfaced with a videodisc machine, with a peripheral such as a Whitney Interface Card.

For those readers interested in the more technical aspects of the videodisc, it is a disc that may contain as many as 14 billion tiny indentations arranged in up to 54,000 circular tracks. These pits are the information source. A beam of light focused down to 1/30,000,000 of an inch, passes through the plastic layer, striking the pits which interrupt the reflected beam. This on/off reflected beam is then translated into electronic impulses. Each of the 54,000 circular tracks is equivalent to one television frame. Although the tracks are not of equal quality or size, the size does have an effect on their readability.

When the videodisc is played under the control of the microcomputer, it is possible to repeat video tracks at different rates of speed, or even freeze a frame. The microcomputer controls the 54,000 frames on the disc. The key factor is "control." The microcomputer is controlling both the interaction with the videodisc software and the responses (input) from the trainee. Thus, while the videodisc is providing a television type presentation such as a demonstration or slides with video and/or printed subtitles on the screen, the microcomputer program is controlling the interaction between the videodisc and microcomputer presentations. Also, the capabilities of the microcomputer allow it to present textual material, ask questions or branch the material on the basis of individual responses.

In summary, the videodisc or videotape, in combination with the microcomputer, integrates the technologies of the book, television and computer-assisted instruction into one medium.

An Example - The Wisconsin Foundation for Vocational, Technical and Adult Education, Inc. has been involved in the development, implementation and distribution of a sophisticated interactive computer-video learning system which tracks basic electronics.

Several years ago, the Foundation successfully developed a linear video series called "Basic Electricity and AC-DC Circuits." In the early 1980's, the Foundation began a relationship with the College of San Mateo, located in the Silicon Valley in California. Together they developed a more sophisticated instructional package on electronics.

Governor Brown had initiated a program to halt the slump in American science and technology and to end the shortage of skilled technicians in California. The College of San Mateo received substantial funding through the California Worksite Education and Training Act to develop a training approach for that geographic area. Staff members in the electronics department wanted to create a teaching system which used video, was interactive, and required active participation by the user. They also wanted a system that was competency-based, individualized, self-paced, open-entry/open-exit and computer-managed.

The faculty a the College of San Mateo then blended video technology, the microcomputer (the Apple II) and the curriculum developed by the Foundation on Basic Electronics and AC-DC circuits. The system is set up as a "learning station." Included are the electronics lab equipment, a microcomputer, video player, and monitor. A telephone is also provided, allowing direct access to an instructor for consultation during the instructional sequence.

Trainees are then guided through the course by following structured study guides. The course is divided into modules. For each module there is a separate box of diskettes and corresponding videotapes. There are up to five different learning activities included in each module:

1) Active Homework Review - The trainee uses review diskettes and answers questions on the previous homework assignments to refresh the trainee's memory and to indicate whether s/he is ready to begin the next module.

2) Pre/Post Test - The video component is not used during this activity. If a trainee feels that previous knowledge and experience make it unnecessary to proceed through a particular module, s/he can test out of the module by passing the pretest. The post test is used by all those who complete the module. It must be passed before moving onto the next module. The tests include 10-12 questions randomly generated by the microcomputer from a batch of approximately 125 questions for each module.

3) Theory Lessons - Almost all the modules include at least one lesson on the theory and knowledge base needed in order to perform the laboratory applications. During this part of the instructional sequence, the video and computer components are utilized. The Apple controls the video, showing only 2-3 minute segments of video which are followed by computer-generated directives or questions. Trainees cannot advance to the next segment of video unless the questions are answered correctly. Wrong answers automatically activate the system to provide a video review segment. Right answers are acknowledged in a positive manner.

   There are several other controls for the user. The tapes can be paused by pressing the space bar or pressing the "H" key. The trainee can then choose to rewind 20 seconds, fast forward to the next stop, see the menu, quit or continue.

4) Skill Modules - These are usually brief interactive video lessons which sharpen specific skills needed to complete laboratory applications. For example, operation of the oscilloscope is taught by guiding trainees through the procedures for setting up and operating an oscilloscope by an interactive hands-on experience.

5) Lab Jobs - The interactive lab jobs are the most powerful learning tools in the system. Lab experiments are illustrated and explained on video during which trainees are given specific instruction for setting up equipment, making correct connections and setting appropriate dials. Trainees feed readings and measurements into the computer when required and the computer checks progress throughout the entire experiment. The trainee is not permitted to progress to the next phase of the experiment until all previous procedures have been correctly executed.

The System Manager - A diskette that manages the instruction during the entire instructional process is put into Disk Drive #2. It is used to keep track of the trainee's performance. The System Manager also checks I.D. numbers and determines whether or not a trainee has the instructor's permission to work on a particular activity. The manager also records the time and date the trainee begins and ends an activity and keeps accurate test scores.

This system has been used in traditional educational settings and also adapted to nontraditional educational settings. For example, in California, the training package and learning stations have been installed in several prominent electronics companies for upgrading entry-level employees and providing college credit courses through on-the-job training. In Minnesota, this system has been adapted for voice activation so that it can be utilized by special needs students. Students who are usually unable to complete a lab operation which requires use of both hands employ the voice activation module, thus eliminating the need to use their hands to input data. This Voice Input Module allows one word or short phrases to activate commands.

In Michigan, the system is being used at one of the prisons to teach electronics. For the first time, the instructor sees positive results in the educational program. Important components which prisoners are especially sensitive to are, one, having their own personal space to learn and two, maintaining control over their learning and educational environment.

In Wisconsin, the modules are being used by Job Service clients who, in 30 weeks, can learn basic electronics and get a job in an electronics-related occupation.

These are several examples where computer technology is used to enhance a curriculum, especially a competency-based, self-paced curriculum. Many companies, both technical and educational, are beginning to recognize the power of this medium and are able to envision its place in vocational education. The industry is still in its infancy stage but it is worth keeping abreast of the developments in this field.

Statewide Microcomputer Network for Vocational Education

The state of West Virginia has installed a model Statewide Microcomputer Network which will initially be used solely for vocational education. The network was designed with a laboratory configuration which operates off a large mainframe with numerous terminals. Although problems connected with networks were identified, it was felt that the network concept would allow schools to have access to expensive software, require fewer peripherals and would allow area schools to access large amounts of data stored in a larger mainframe. The school system decided to purchase microcomputers that could either function as a terminal for the mainframe or, in the event that the mainframe was not working properly, could act as a standalone microcomputer with its own memory. Microcomputers/terminals could also be detached from the system and taken to another classroom or even taken home to write lesson plans.

The computers are not used merely to teach computer-related topics, such as programming and data processing, but are used to teach students how to use existing applications packages, e.g., electronic spreadsheets and database management programs. Students are also encouraged to use the computers to solve occupationally-related problems. For example, students in marketing learn how to control inventory with the computer, make sales projections and complete data analyses. Students in agriculture learn how to manage crops and finances on the farm.

The hardware selected was the IBM PC and the Corvus Ominet. The configuration is as follows at each location. There are 20 microcomputers with 128 Kbytes of memory each and four printers. The Corvus Omninet includes a 20 Mbyte disk library and a disk server or control unit. It is under the teacher's control.

Several unique components of the computer-based plan were established in West Virginia including:

- Factory training for eight persons in the school system who are then responsible for the repair and maintenance of the equipment. These same individuals will also teach computer repair courses in vocational centers.
- Students are given a 12 percent discount on the purchase of an IBM PC system so that work could be completed by the student at home or in the laboratory.
- Teachers and administrators can take advantage of a 20 percent discount from IBM for the purchases of equipment.

The second phase of the plan will be to install similar systems in all vocational centers and 12 high schools so that there is a network in every county. The third phase would provide microcomputers in all elementary and secondary schools.

Using an Apple-Aid With Handicapped Students

Wisconsin's Department of Public Instruction has established the position of "Designated Vocational Instructor" (DVI). This person is responsible for assisting handicapped students so that they may enter and participate in existing vocational education programs. At Turner Senior High School in Portage, Wisconsin, a portion of the DVI grant money was used to purchase an Apple II computer system to act as a "teacher's aide." The capabilities of the microcomputer have led to an expanded program. As evidence of the usefulness of this instructional tool, prior to the use of a computer via the DVI, 23 percent of the students classified as EEN received F's in their vocational education courses. With the use of the computer, only 8 percent received F's.

The microcomputer has been used as an adjunct instructor. The DVI tries to provide students with the special help they will need to successfully complete a particular course. With the microcomputer, this means collecting information from the vocational instructor and typing it onto a disk, usually with an authoring system that can be adapted to any subject matter. Review questions for tests are also entered into the program. The copy can be reviewed by the instructor for accuracy and then revised, if needed.

Students can independently study the disk. Repetition, often needed by special needs students, is available via the microcomputer until the information is mastered. An example of its usefulness follows. A safety test needs to be passed before a student is allowed in the high school metal shop. If a student cannot pass the test, projects cannot be started. With the Apple, a student can spend as much time as needed studying rules and regulations so that projects can be started with the rest of the class.

Commercially written software is also used, such as math tutorials, typing/keyboarding programs and glossaries. Thus, if a student has a weakness in a skill that is necessary for successful completion of a program, s/he will be assigned a disk and will keep repeating it until the skills are mastered.

Conclusion

These are but a few examples of how microcomputer technology can be integrated into a vocational education curriculum. The remainder of this book contains profiles which illustrate other methods of implementation. A variety of subject areas were included and a sampling of different methodologies used in various settings are highlighted. These are simply examples of successful programs. Generalizations beyond the specifics are worthwhile and will hopefully bring you to more advanced levels of technology usage in the vocational education classroom.

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COORDINATING THE USE OF MICROCOMPUTERS DISTRICT-WIDE

Although it is often not feasible or possible to implement microcomputer-based instruction district-wide, it is considered by many educators to be the most effective way of developing stable policies which direct the use and growth of microcomputers in public education. A district that has done this, and done it successfully, will now be examined in regards to the planning and implementation procedures governing the use of computers in the classroom.

DISTRICT: Oregon School District
ADDRESS: 200 North Main Street, Oregon, WI 53575-1499
TELEPHONE NUMBER: (608)835-3161
INSTRUCTIONAL PROGRAM: District-Wide
CONTACT PERSON: Roland Cross, Director of Instruction

The Oregon School District in Oregon, Wisconsin has approximately 2,500 students in grades K-12. There are three buildings which house the elementary grades: a K-3 elementary school (N=525), a K-6 elementary school (N=325), and a middle elementary building with grades 4, 5, and 6 (N=400). A junior high school with grades 7 and 8 (N=410) and one senior high school with 850 students is also in the district.

History

Approximately seven years ago, in 1978, the school district received a foundation grant from the Apple Computer Corporation so that they could be part of a reading study in conjunction with the University of Wisconsin. The study examined critical reading skills. The goal of the study was to write software that could be used to develop and evaluate critical reading skills. With the grant, Oregon schools also received their first two Apple II+ computers. A faculty member from the University of Wisconsin's psychology department, Alex Wilkinson, wrote the software. The students in the Oregon District piloted the programs.

Since that time, the district has become heavily involved in computer-assisted instruction. There are now 60 computers in the district. All students are required to take at least two courses which focus on computer literacy. The first course runs for nine weeks during 7th grade, and the second, also for nine weeks, is designed for 8th graders. During that time, students learn BASIC and practical applications related to other academic subjects such as science and social studies. They also have access to programs downloaded from a centralized source (to be discussed later) titled Solutions Unlimited. In addition, LOGO has been introduced into the elementary school through a special summer project and will eventually become part of the second and third grade curricula.

The philosophy guiding the integration of microcomputers into the classroom has been to zero in on the curricular areas with the greatest need and implement CAI in those areas, rather than studying and developing curriculum around long-term needs.

The first formal computer-based instruction course began in the junior high school as the literacy course. At the same time, Computer Science (a programming course) was added to the high school curriculum in the math department. The programming course has now developed into a two-course sequence: "Programming BASIC" and "Problem-Solving With Higher Level Languages." In the problem-solving course, students study Pascal and learn the application of various programming languages in occupations such as those involved in the computer-based operations of the State Highway Department. Apple IIe's and Apple II+'s are used in the courses. The curriculum is taught in two formal labs; one is in the senior high school and one is in the junior high school. A third lab containing Apple IIe's was recently completed and is dedicated to classes and projects in business education. In addition, there are four computers in each elementary building.

Inservice Training

The district has strongly supported inservice training for their faculty. All faculty and staff have had at least 20 hours of instruction on "The Introduction to Computers." Faculty are paid to attend these classes. Many faculty members have also studied advanced applications software such as PFS, Visicalc, and practical applications in grading, administering the IMC, etc. Elementary school teachers will have the opportunity to take a short course in LOGO before it becomes their responsibility to introduce LOGO in their classrooms. These courses are all completed with district support.

As the reader can see, the integration of the microcomputer into the classroom has been strongly supported by the administration from the very beginning. This is a critical factor which contributes to enhancing the creativity of the faculty and developing their capability to initiate and pursue ideas related to the use of technology in the classroom. Not only is the administration's support seen in the attitude of acceptance and financial backing (paying for inservices and equipment) but also in the availability of microcomputers for staff from the stage of idea development through constructing lesson plans, to implemention of the ideas in the classroom. Faculty can use the computers in the lab or check them out and take them home. Lab instructors are there not only to supervise students but also to spend considerable time helping faculty explore the uses of the microcomputer. Faculty are also allowed to check out software, manuals and use the capabilities of the computer science teacher to provide solutions for their programming needs.

Short workshops are continually being developed by the district to develop skills which will enable faculty to integrate the microcomputer into the classroom. The following workshops, for example, were offered to all teaching and administrative staff. They are fairly typical of the kinds of learning activities made available to the faculty on a regular basis.

Introductory Computer Workshop

This short but intense workshop is for those who have not yet found time for an introduction to the microcomputer or perhaps for the occasional staff member that may want a refresher. This workshop is intended to be a real "hands on" experience. With the assistance provided in this class, the user will be expected to write a short program which can be used in the classroom. Enrollment will be limited to 20 staff. Total Hours - 126 sessions - Time - 3:45-5:45 at the senior high school computer center (the Lab). Credit/Stipend - one workshop credit and a $35.00 stipend will be issued upon completion of the full 12-hour workshop--no partial credit or stipend will be issued.

Practical Applications - Computer Workshop

Would you like to become familiar with a program that would allow you to introduce word processing in your classroom? Would you like to find out more about how you can use a simple file and a simple report program that will assist your recordkeeping operations?

If you have interest in this workshop, Marcia will help you in understanding the practical applications of "Bank Street Writer," "PFS File," "PFS Report" and others. She will also introduce you to another language other than BASIC. You should also know that this workshop will require some outside-of-class preparation time. Enrollment will be limited to 20 staff. Total Class Time - 20 hours/8 sessions - Credit/Stipend - two workshop credits and a $70.00 stipend will be issued upon completion of the full 20-hour workshop.

The philosophy behind the support provided for faculty is the following, "Introduce the faculty to the concept and then give them the time and support to both experience it and implement it." An example of the kind of support available to faculty and the tangible results from it can be seen in the Instructional Materials Center (IMC). A pilot project was developed to automate the library. As part of the project, the IMC director attended a workshop for training. With that training and additional equipment, the IMC director will totally automate the Center by the end of 1985. An Apple IIe will be utilized for checkout and to automate the shelf list. The staff has also been granted release time from the district to operationalize these concepts.

Now that the idea of computers has been accepted by most of the faculty, the administration is finding that the lab is so heavily scheduled that it is not available as often as hoped for new uses and applications. For example, the accounting and clerical practice classes want to use the same lab as the computer science courses and that has caused scheduling problems. One solution has been to establish a satellite lab dedicated to business education.

Another solution utilized by the district has been to look carefully at each department that is requesting a computer, such as agriculture and auto mechanics, and determine whether it is justified to buy a machine to be utilized solely in that area. For departments such as those, that are physically located far from the computer labs, the innovative ideas will never be implemented unless they have a computer available to them at regularly scheduled times of the day.

This solution, although convenient, presents a security problem. Wheeling computers around the school creates problems as does having one computer per classroom throughout the school. It is difficult to use the same level of electronic surveillance all over the school in the way it is used in the labs, although it would be ideal.

Although the solutions to the staff's new needs are being met at a slower pace than ideally hoped, the staff is aware that the administration is trying to meet all their needs. That, in itself, has led to a very positive feeling amongst the faculty concerning the integration of microcomputers into the classroom.

How Have Microcomputers Been Integrated?

Agriculture

Microcomputers have been used to calculate ration balancing, potential crop yields, and to complete calculations for agricultural accounting projects. The instructor first teaches the concepts in a traditional manner and then shows the students the efficiency of the computer as a tool to complete the same calculations and paper work. One innovation built into the program included inviting parents, many of whom are farmers, to the class when the microcomputer was introduced. Two companies provided software for the Ag class: The Wisconsin Agricultural Computing Company and Specialized Data Systems, both in Madison, Wisconsin.

Special Education

Special Education funds support the one microcomputer located in the resource room at the senior high school. Because special education funds can also be used for mainstreaming, the special education unit also contributed some money to the lab. No peripherals have been bought for the handicapped because the visually impaired in the district go to the Janesville school system and the hearing impaired go to the Madison Public Schools. The only handicapped students which attend the Oregon schools are those with learning problems.

There is a staff of 20 in the special education department. The administration has been encouraging them to utilize the lab. To date, the lab has been used most effectively when in teaching basic skills. The computer is also frequently used as a motivator with mostly drill and practice software developed by MECC in Minneapolis, Minnesota.

Career Guidance

The Guidance Office uses the Wisconsin Career Information System (WCIS) for career counseling. WCIS is a comprehensive system of career exploration designed especially for Wisconsin. Through its printed materials, and microcomputer or mainframe programs, WCIS provides up-to-date educational and labor market information for making career decisions. With WCIS, students can identify interests, match to occupations, learn about training programs and majors, and the schools and colleges offering them.

Business Education

The business education department in the high school has recently obtained 12 microcomputers (Apple IIe's) which they have structured as a dedicated lab. During class time, they are teaching word processing principles, spreadsheet analysis, and database management.

Elementary School

Grades 4-6 are starting to develop a coordinated plan for integrating the microcomputer into the curriculum. LOGO is currently introduced to primary level students via a special summer project. It will soon become part of the second and third grade curriculum. All students in grades four, five and six are taught hands-on lessons in computer awareness, keyboarding and problem solving.

During the Summer of 1984, a committee of 4th, 5th, and 6th grade teachers formed a computer curriculum group and developed recommendations for integrating the computer into the curriculum during the elementary years. Their recommendations, including curriculum goals and objectives, follow. The goals and objectives illustrate the process that a district must go through before beginning to implement any long-range goals.

Summer 1984
Grades 4,5,6
Elementary Level

RECOMMENDATION SUMMARY FOR TEACHERS

The summer computer curriculum group is recommending that:

1. All middle school students should be instructed in proper care and use of computer hardware and software, and in how to RUN a program from a CATALOG. Students shall be licensed after passing a performance test at the computer. Only licensed students may use the computer.
2. All students be scheduled in pairs every week for 25-30 minutes at the computer. Students will most often be using disks and programs assigned by the teacher (some of which will accompany classroom lessons.)
3. Computers remain in the computer center, with one computer reserved for each unit for their student's use.
4. Each unit will provide the IMC director with their schedule, so that unscheduled times (possibly sometime between 11:15 and 12:45, lunch hour times) can be made available to any units' students.
5. Very basic lessons on (1) Computer Awareness, (2) Keyboarding, and (3) Problem Solving be taught in the classroom, given suggested objectives and materials. (See attached sheets.) A total of eight half-hour classes are suggested.
6. To make room for these lessons in an already crowded schedule, suggestions are being made for "in place of what." Each team, each grade level, and the teaching staff in general will need to help make the decision through the IMC.

   Some possibilities are to:

   a) Reduce spelling requirement to fewer than 36 lessons per year.

   b) Delete a social studies unit or part of a unit (good possibility in 4th grade curriculum).

   c) Delete a science unit, or part of a unit.

   d) Any combination of the above.

NEEDS FOR MIDDLE SCHOOL (4th, 5th and 6th grades) (to be able to implement recommendations of the summer computer curriculum group).

Disks

1. "Typing Teacher" by Computations
2. "Master Type" by Lightning Software
3. An operational "Friendly Computer" disk
4. Disks to accompany shows 1 and 2 of the videotape SOLUTIONS UNLIMITED

Other Needs

1. Six (6) large 24" x 36" posters of the Apple II Keyboard, laminated for checkout from the IMC by teachers.
2. 400 cards (white, light-weight tag like the math cards are run on) with the Apple II keyboard on them for kids to have and use. These should probably be done by offset printing.
3. Copies of "Basic Computing - A Scholastic Skills Book" for each unit. We may already have enough of these.
4. Worksheets and other materials to accompany SOLUTIONS UNLIMITED videotape on problem solving.

COMPUTERS
COMPUTER NEEDS

There is a need for a minimum of eleven computers for the Oregon Middle School at this time. There is a need for one computer for use by the IMC and/or teachers. One computer is needed for the aides and/or teachers, and there is an urgent need for nine computers for classroom use.

The rationale for the use of nine classroom computers in the Oregon Middle School is based on the following guidelines. It is recommended that students have a minimum of one-half hour per weak at the computer. Computers must also be available for students during the day for enrichment and extension work, in addition to their scheduled time.

Initially, it is hoped that the lunch hour (11:15 - 12:45) would be available for added student access for enrichment and extension. The remaining time for computer access allows 4.5 hours per day or 22.5 hours per week.

Twenty-two and a half hours per week opens one computer to 45 children within the regular schedule. A student body of 400 would therefore require 8.8 computers for the minimum goals set for the Oregon Middle School.

This does not include, of course, the problems of program running time, lapses in the schedule, recesses, or any other timing problems. This assumes that the ideal has been attained—each student arriving at the computer and completing his given task punctually. This deal also requires that computer use starts at 8:30 in the morning and ends at 2:30 daily.

COMPUTERS
LONG-RANGE RECOMMENDATIONS

A committee is urgently needed to review software. There is so much software being developed and promoted today that confusion is generated within some school districts. Much inferior software is being bought at the expense of school districts' budgets because of extensive effective marketing. Software review is a time-consuming and difficult job and cannot be done in addition to regular classroom responsibilities without added remuneration. Some tasks for this committee could be:

- outline SKILLS utilized in a program
- evaluate psychological effect upon students
- encourage use of programs within the classroom
- analyze the value of a program

Possible in-service may be necessary if the district continues to expand its computer curriculum. The use of LOGO, the introduction to programming, or the implementation of certain software may require extended instruction for staff.

The district may wish to consider developing a summer school course designed exclusively for elementary students in the basics of keyboarding as opposed to formal typing.

The district should be prepared to expend added dollars or added curriculum work in the area of computer education. Some areas for consideration may include:

- Lessons designed for learning inductive reasoning
- Flow charting and logical thought
- Base 2 instruction
- More extended execution of written instructions
- Problem solving as an approach to classroom learning, instead of emphasizing content
- Instruction in seeing patterns

COMPUTERS
IN PLACE OF WHAT!!

We can no longer expect teachers to include added instructional material to the curriculum without seriously addressing the problem of time. Each new class of instruction crowds into an already crowded school day. We must therefore address the issue of "in place of what" if we require our instructional staff to address new curricular issues.

We are assuming that each lesson being recommended requires instructional time of one-half to one full hour. Three days of computer awareness activities in each grade is equivalent to 1.5 hours. Three days of keyboarding activities in each grade is equivalent to 1.5 hours. Two days of an introduction to problem solving in grades 5 and 6 is equivalent to 1 hour. Also being recommended is that all students have a scheduled period of 30 minutes each week to work on the computer. It must be recognized that this computer access time per student equals 18 hours of lost classroom time per year.

Although we assume that the time at the computer is profitable and will spill over into the learning process in the classroom, we still must address the loss of face-to-face teacher/student interaction. It is therefore our intent to offer suggestions to answer the important question of " in place of what?"

Schoolwide it has been suggested that we realign our spelling standards to say that 30 (or some number less than the current 36) lessons will now be considered a complete year of work. This will relieve certain tensions to complete 36 lessons in one year. We can include lessons 31 to 36 as extension and/or enrichment activities. Those on an individual spelling program will complete requirements on an individual basis.

It has also been suggested that each grade level discuss course deletions. With the additions of new curricula in recent years, teachers have been unable to successfully complete the overload social studies curriculum in both fourth and fifth grades. It is for this reason that we are suggesting that each grade level come to a decision as to which units it feels can be deleted from the yearly schedule. This will at least free up some of the tension felt at the end of each year because certain units have not been taught--if they are no longer written down on the yearly schedule, we no longer need to feel the pressure to complete them. For sixth grade, the science curriculum may need careful study.

It is then through the IIC that these changes can become a reality. There is a strong feeling by the administration that the question of "in place of what" must be addressed and satisfactorily answered. It is hoped that the staff will take this opportunity to do just that.

COMPUTERS - LICENSING

Before students will be allowed to use the computer independently, they will be required to pass a performance test at the computer. Upon passing the test, the librarian will issue an official license (card) to the students. Classroom teachers will be asked to assist in the licensing process as much as they feel able. One suggested time to do such licensing is during IMC time early in the year.

Grades 4, 5, and 6:

OBJECTIVES:

Students will demonstrate the proper care and use of computer hardware and software.

Students will demonstrate how to insert the disk, turn on the computer and RUN a program.

Students will be able to run a program from a catalog or menu.

IMPLEMENTATION OF OBJECTIVES:

1) Steps for inserting and preparing to boot a disk properly:

   A. One must not touch the exposed center of the disk or the oval cut-out.

   B. Do not bend the disk.

   C. Always put the disk back into its protective jacket after using it.

   D. Keep the disks stored upright away from the monitor and out of direct sunlight.

   E. Insert the disk with the label side up and oval pointing into the disk drive.

   F. Close the door to the disk drive.

2) How to turn the computer and monitor on and off:

A. Use the toggle switch on the back, left side of the computer carefully. If another power source is available, switch the computer on at that source. On computers secured to carts, the switch is on the right-hand side of the TRACE.

B. Turning the MONITOR on and off while the computer is on does not affect the program currently in memory.

C. To turn off the computer during the day without switching off the power, press the <CTRL> and <RESET> keys simultaneously. To boot a new disk, put the disk in the drive and type PR#6 and press <RETURN>.

For teacher information:

D. It is okay to turn the computer on and off by using a switch or by plugging and unplugging the machine.

E. The on/off switch on the monitor has nothing to do with sound. The sound emanates from the Apple computer itself. Try pressing <CTRL-G> for a beep.

3) How to catalog the disk:

A. When the computer is first turned on and a disk is in the disk drive, the CATALOG should come up on the screen automatically. If it does not, just type the word CATALOG and press the <RETURN> key.

B. After the student has selected a program from the CATALOG (also called a MENU) the student should type the word LOAD followed by the name of the program and press the <RETURN> key.

C. When the red light on the disk drive is on, students must avoid typing. When the cursor reappears on the screen, the student should type RUN to execute the program.

COMPUTERS - KEYBOARDING

Grade 4:

All students will be able to place their hands in home position.

All students will be able to type their first names, using the proper fingers.

All students will have the knowledge of using the fifth finger of the right hand for RETURN.

All students will have the knowledge of using the thumbs for the space bar.

All students will be exposed to the "Zebug" program on the Friendly Computer disk as an introductory keyboard awareness activity.

Grade 5:

All students will review Grade 4 objectives.

All students will be able to type their first and last names using the proper fingers.

All students will be exposed to levels 1 and 2 of "Typing Teacher" or another suitable touch-typing computer program.

All students will use the Apple Tutorial disk as further exposure to keyboarding awareness.

Grade 6:

All students will review Grade 5 objectives.

All students will be exposed to levels 3 and 4 of "Typing Teacher" or another suitable touch-typing computer program.

All students wishing to use "Bank Street Writer" (or another word processor) independently will have completed all levels of "Typing Teacher" or its equivalent.

COMPUTERS
KEYBOARDING IMPLEMENTATION

Grades 4, 5 and 6 (1984-1985 school year only??)

Time: 1-1.5 hours
Materials: Apple Computer Keyboard Sheet
Crayons
Objectives: To introduce students to the Apple Keyboard
To expose students to proper hand position
To give students a reference sheet for letter location on the keyboard
To give students a sheet for typing practice

Procedure:

1. Color the following yellow:
   5th finger on both hands
   letters A and +/;

2. Put yellow X's on the following keys:
   Q, 1, Z, and SHIFT; P, O, */:, =/-, ?//, SHIFT, and RETURN

3. Color the following green:
   4th finger on both hands
   letters S and L

4. Put green X's on the following keys:
   W, 2, and X; 0, 9, and >/.

5. Color the following blue:
   3rd finger on both hands
   letters D and K

6. Put blue X's on the following keys:
   3, E, and C; 8, I, and </,

7. Color the following red:
   2nd finger on both hands
   letters F and J

8. Put red X's on the following keys:
   4, R, V, 5, T, G, and B; 7, U, M, 6, H, and N

9. Color the following brown:
   thumbs
   SPACE bar

10. Draw a black line between the following letters and then connect
    5/6, T/Y, G/H, and B/N

11. Discuss with the class
    - Home position (fully colored keys)
    - Black line denotes right and left halves of the keyboard and thus the left and right hands
    - Colored keys and X'ed keys designate the correct finger usage
    - The SHIFT key is used to get the upper level characters on the keyboard

Recommendation: One day per week at the paper keyboards emphasizing

- Y and N
- SPACE
- RETURN
- Typing name with proper fingers
- PR#6 (with use of the SHIFT)
- Control Reset

COMPUTERS - AWARENESS

Grade 4:

All students will view the filmstrip "Everyday Computers" from the SVE kit COMPUTER AWARENESS.

All students will be exposed to a discussion of the above filmstrip, complete the worksheet "Computers and Careers" included in the kit, and participate in any other related activities the teacher plans.

All students will use the disk "Everyday Computers" included in the SVE kit during their scheduled computer times.

All students will take the post test included in the kit.

Grade 5:

All students will view the filmstrip "What Computers Do" from the SVE kit COMPUTER AWARENESS.

All students will be exposed to a discussion of the above filmstrip, complete worksheets #1, 4, and 5 in the kit, with worksheet #2 optional and #3 for enrichment, and participate in any other related activities the teacher plans.

All students will use the disk "What Computers Do" included in the kit during their scheduled computer times.

All students will take the post test included in the kit.

Grade 6:

All students will view the filmstrip "How Computers Work" from the SVE kit COMPUTER AWARENESS.

All students will be exposed to a discussion of the above filmstrip, complete worksheets "7, 8, 9, 10 and 11 included in the kit with the option of progressing on to flowcharting, and participate in any other related activities the teacher plans.

All students will use the disk "How Computers Work" included in the kit during their scheduled computer times.

All students will take the post test included in the kit.

Interested students may view the filmstrip "Basic Programming" in the same kit, and use any supporting worksheets.

COMPUTER AWARENESS
ADDITIONAL IDEAS AND ACTIVITIES

Grade 4:

Show filmstrip "Everyday Computers" from SVE COMPUTER AWARENESS KIT.

Students might brainstorm a list of careers or jobs which are or may be computerized in the future. Also may involve discussion of how computers may affect various aspects of each career. (Library has some good books on this topic.)

Assign a creative writing project on the future of computers.

Make a bulletin board of pictures from magazines, etc, which show computers in our everyday lives, i.e., traffic lights, telephone, grocery checkout, etc.

Grade 5:

Show filmstrip "What Computers Do" SVE COMPUTER AWARENESS kit.

Have a "Calculator-Computer Electronics Day" in the classroom. Students should bring any calculators, appliances, games or toys which are electronic gadgets.
Kids without access to above may cut pictures from magazines.

Using some older encyclopedias or dictionaries, have students look for computer-related words, such as "computer." For ideas of such words, see glossary at end of SVE COMPUTER AWARENESS teacher's manual. This activity will indicate the recent growth of this industry.

Use the following pages from the Scholastic Skill Books BASIC COMPUTING:
  Book D - pgs. 4-9
  Book E - pgs. 4-9
  Book F - appropriate pages

Grade 6:

Show filmstrip "How Computers Work" from SVE COMPUTER AWARENESS KIT.

Take students on a field trip to a local bank or industry that uses computers.

Have students visit a local computer store and bring back promotional literature. These materials may also be sent for. Make a display to show the variety of computer products available.

Use the classified section of the newspaper to identify career choices in computing. Students can also compile a vocabulary list dealing with computing (data processing) and programming.

Use the following pages from the Scholastic Skills Book BASIC COMPUTING:
  Book D - pgs. 10-15, 38-39
  Book E - pgs. 28-29
  Book F - appropriate pages

COMPUTERS - PROBLEM SOLVING SKILLS

Grade 4:

All students will use appropriate problem solving and thinking skills software throughout the year.

Grade 5:

All students will view the SOLUTIONS UNLIMITED videotape for Program 1, "Hey, Wait! Think, See, So?," and participate in discussion afterwards.

All students will use the computer disk that accompanies Program 1, during their scheduled computer time.

All students will use appropriate problem solving and thinking skills software throughout the year.

Grade 6:

All students will view the SOLUTIONS UNLIMITED videotape for Program 2, "Plan Ahead - Time Management and Problem Solving" and participate in discussion afterwards.

All students will use the computer disk that accompanies Program 2, during their scheduled computer time.

All students will use appropriate problem solving and thinking skills software throughout the year.

COMPUTERS
PROGRAM USAGE

Grade 4:

Awareness
- Computer Awareness (Program 3 - "Everyday Computers")

Keyboarding
- Friendly Computer (Program 3 - ZeBug)

Problem Solving/Thinking Skills
- Hurkle (MECC Vol. 1) P.S.
- Lemonade Stand (MECC Vol.) P.S.
- Pied Piper Pipes Again, The T.S.
- Revenge of Rumplestilskin, The T.S.
- Who Stole Cinderella's Slipper? T.S.

Grade 5:

Awareness
- Computer Awareness (Program 1 - "What Computers Do")

Keyboarding
- Apple Tutorial
- Typing Teacher (Program levels 1 and 2)

Problem Solving/Thinking Skills
- Factory, The P.S.
- Lemonade Stand (MECC Vol.) P.S.
- Oregon Trail (MECC Vol. 6) P.S.
- Moptown Hotel P.S.

Grade 6:

Awareness
- Computer Awareness (Program 2 - "How Computers Work")
- *Computer Awarensss (Program 4 - "Basic Programming")

Keyboarding
- Typing Teacher (Program levels 3 and 4)
- *Typing Teacher (Program levels 5, 6, 7, and 8)
- *Master Type
- *Bank Street Writer

Problem Solving/Thinking Skills
- Factory, The P.S.
- Moptown Hotel P.S.
- Problem-Solving Strategies P.S.
- Snooper Troopers #1 P.S.
- Taxman P.S.

*Enrichment/Extension

Industrial Technology

Not much has been done with microcomputers in the industrial technology department, to date. The graphics department wants to become involved but have not yet received the necessary equipment nor training. Auto mechanics foresees using the microcomputer but other tasks need to be completed before it is clear how the microcomputer will be integrated into the instruction and/or management of the curriculum.

IMC

The IMC will be using Wehner Educational Software - the "Catalog Card" and "Label Writer" programs to automate the IMC. An Apple IIe will be used to process all hard cover books and A-V materials. Student librarians will enter the paperback collection into the computer to provide both an inventory and computer card catalog using the Electronic Library Aide. The "Orchard Systems Circulation Management System" will provide slips and lists for overdue materials and the library software. "A-V Catalog Writer" will be used for parent volunteers to enter the A-V holdings. Inventory will be possible by both the Dewey system and by subject matter. "PFS File" and "PFS Report" have been used to create files that permit the staff to accomplish a variety of library tasks. They include magazine check in, budget, purchase order reference, paperback labels and catalog cards, bibliographies, and data for future orders.

Classroom Management

Teachers are using the "Classroom Manager" published by the Merlan Microcomputer Series, for grading. They have also developed personal management systems for use in their particular classes. It looks as though the McMillan R Management System for Reading will be purchased for more efficient recordkeeping of the reading program. It is assumed that a teacher's aide will be responsible for data entry, retrieval, etc. in the reading program.

Evaluation

No formal evaluation has been made regarding the utilization of the computer in the classroom. The administration and staff are comfortable with the feeling that students know enough about computers to recognize their importance. There is no question about the positive motivating effect the microcomputer has had on instruction. It is unknown still how to best use the computer to problem-solve and recordkeep, which are the emphases of the computer-based instruction in this district, rather than mere drill-and-practice.

The Bord Warner Program for Critical Reading has not been formally evaluated either but an evaluation would probably show that students do a better job in the area of critical thinking than they had before completing the instructional program.

The Future

The most important concept in the implementation of computers into the curriculum at the Oregon School District has been the focus on staff, both through inservicing and continued support of their ideas and activities. "If you cannot convince the staff, the program will lose. The administration must be very supportive and needs to continually encourage the staff to "really make it happen."

In addition to what they have already accomplished, the district is now involved as a one-year pilot site for a program developed by the Education Communication Board (ECB), and connected with the Public Broadcasting System (PBS).

This statewide board in Wisconsin is responsible for Educational TV. A formal commitment has not been made but one project of interest involves the evaluation of software and transmission of the software via subcarrier authority (SCA), or a radio signal to the Apple II memory via a modem. The signals are sent, picked up by the school and software is downloaded.

The software can then be loaded on the disk from the modem. This would eliminate lengthy software evaluations by instructors and curriculum coordinators. Instead, staff would be dependent upon the board for providing the evaluation and sifting process. The member district would pay a receiver fee of $30.00 and need to make the commitment to buy the necessary equipment for the hookup via modem. Currently, ECB is using an interactive series called, Solutions Unlimited which contains eight programs. It is expected that the downloading system will grow and develop until it reaches the goal of statewide access to quality software through downloading from a central source.

INTEGRATING MICROCOMPUTERS INTO THE SECONDARY SCHOOL CURRICULUM

SCHOOL: Glenbrook North High School
ADDRESS: 2300 Shermer Road, Northbrook, IL 60062
TELEPHONE NUMBER: (312)272-6400
INSTRUCTIONAL PROGRAM: School-Wide at the Secondary Level
CONTACT PERSON: Jerry Wicks, Coordinator of Instructional
Materials Services

Glenbrook North High School is located in suburban Chicago serving the students of the Village of Northbrook. It is one of two high schools in the district and is part of a township with five feeder districts. Most of the courses at Glenbrook North are offered under the traditional approach to learning, but approximately ten percent of the courses are taught using the individualized learning approach.

History

In the fall of 1963, with one terminal and a telephone hook-up to Illinois Institute of Technology, Glenbrook North High School offered its first computer course called Senior Seminar. By 1965, a computer library was established within the mathematics department. Data processing and COBOL programming were taught in the business education department. In 1967, three Arkay trainers were purchased to broaden the capabilities of computer power.

By 1974 three separate one-semester mathematics courses had been developed at Glenbrook North; the computer budget reached the $2,000 mark for the first time. The high school had three terminals attached on line which accessed a system at Illinois Institute of Technology. In January of that year, Illinois Institute of Technology's computer could no longer handle all the remote customers who were purchasing services, so they raised their prices. For awhile the programs were processed through district computer services, then located at the other high school in the district, Glenbrook South. At that time, Glenbrook North decided to purchase a Wang programmable computer-calculator. It represented the first step toward developing a computer literacy program for students who were not enrolled in high-level math courses.

The loss of Illinois Institute of Technology as a computing resource for the two high schools caused the Glenbook High Schools to select computing services which could support their existing programs. Glenbrook South joined Concordia Teachers College Computing Network in 1975. Glenbrook North entered into contractual services with National Computer Network with a $4,600+ budget per year. This continued until 1978 when Glenbrook North purchased the PDP-11/03 ($12,000) with three terminals plus one on-line terminal to their own small computer. At that time, four courses had been offered on computers, but in 1978 computer literacy units were added to the Algebra 1 and Geometry classes. It is to be noted that at the time few teachers were familiar with the Digital computer. This put a great strain on the computer teachers and the system, which was used to capacity.

In May 1980, the Board of Education authorized the purchase of eight Apple microcomputers and peripheral equipment for each high school. From that time on, the efforts of the two schools centered on developing a program of computer-assisted instruction.

The success of the CAI program and the acceptance of computer-based instruction by the faculties of the two schools prompted an expansion of microcomputer facilities in 1981-1982. In addition, a formal program of computer literacy was defined by the Glenbrook staff and implemented in mathematics classes.

During 1980-81, the district administration convened a committee of teachers, administrators, and business and industrial computer experts to review the growing needs of educational technology in the two high schools. From this committee's deliberations came the recommendation to purchase extensive, expandable, up-to-date and versatile computer equipment. Digital Equipment Corporation's PDP-11/44 minicomputers, with 12 terminals each, were installed in the schools that year.

The success of the Glenbrook computer facilities has bred exciting challenges for the future. One of the most significant innovations in computer instruction is the implementation of many computer courses in the high schools which are not connected to any specific department, i.e., mathematics and business education, thus making the resources available to all students including the slow learner.

The changing and evolving nature of educational technology is of particular concern to the faculty at Glenbrook North. While taking the inevitability of change into consideration, the committee wants to insure that all students are prepared for the technological impact of the future. They, as a committee, participate in the constant review of curriculum, facilities and instructional techniques. Specifically, they decided to:

1) provide equivalent curricula in the two schools (Common equipment and summer school courses give computing teachers from both faculties an opportunity to define a curriculum),

2) consider the growing sophistication of entering freshmen (The junior high schools have been offering a programming course to many students. Therefore, a computer course for freshman is needed to ensure that students build upon that information when they first arrive at the high school),

3) evaluate the addition of a computer competency test to competency tests already required for graduation, and to

4) develop advanced placement computer science courses (A curriculum proposal based on the college entrance examination board syllabus was submitted to the board as the curriculum planning strategy. The course was implemented in 1983-1984).

(It should be noted that additional teachers were not hired to teach computer-based courses. Staff members have developed their own expertise by attending workshops and taking additional courses.)

The specific computer courses which have been added to the curriculum follow. The administration is just beginning to refer to the list of courses as the Computer Department, which will become a full elective department for grades 9-12. Students need 24 credits to graduate from the Glenbrook High Schools; however, most computer courses do not meet mathematics, applied or fine arts requirements for graduation. When reading this list, note that the numerical portion of each course title designates course content. Under this system, the first digit indicates the sequence in a series of courses; the second digit, the academic level; and the third digit, the sequence within the course. The following should be of help in explaining the system:

First Digit

1 - Denotes the first course in a sequence
2 - Denotes the second course in a sequence
3 - Denotes the third course in a sequence

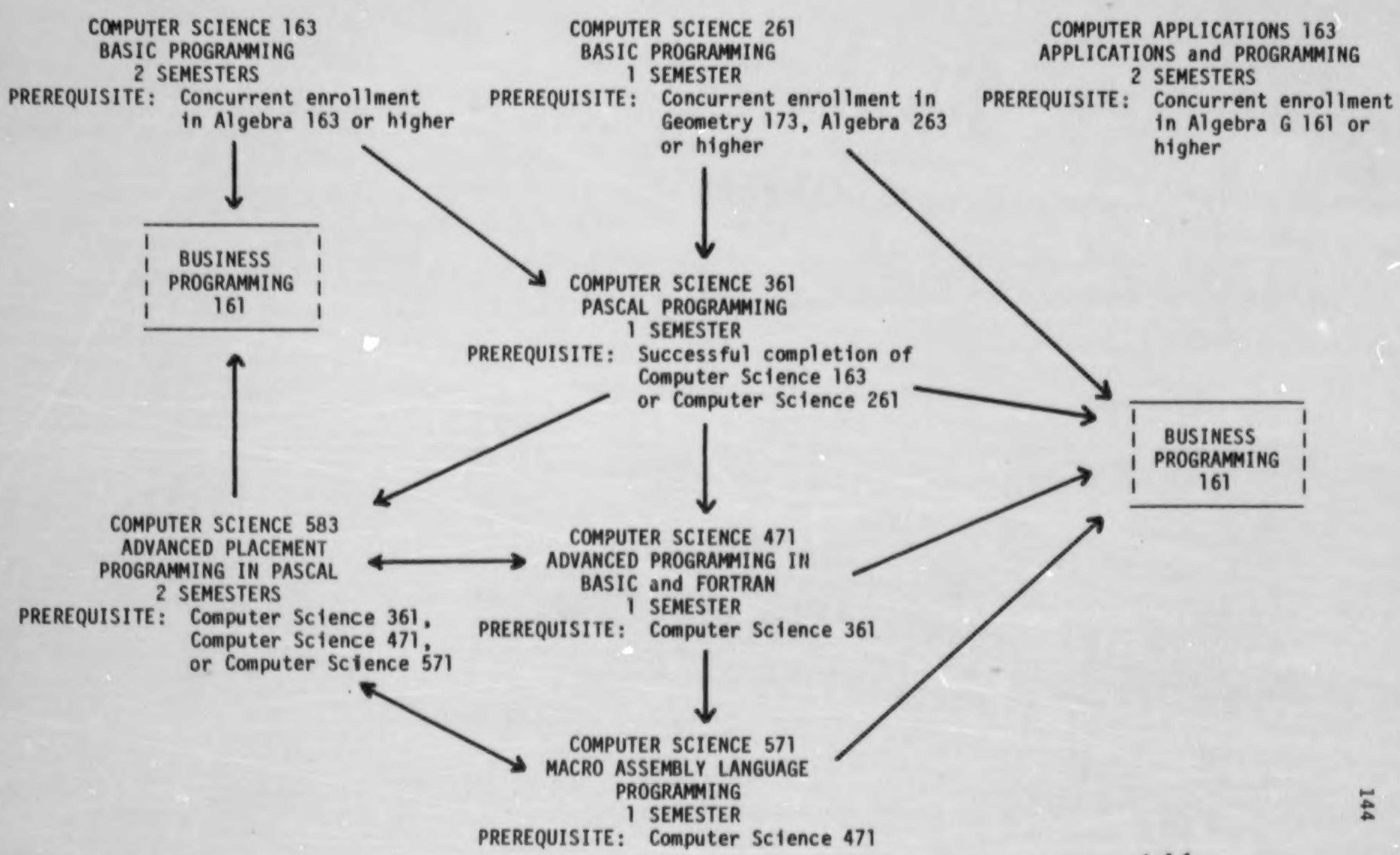
Second Digit

8 - Denotes a sophisticated college advance placement level course. Independent work is expected, and students taking this level course are expected to take an advance placement examination in the course.
7 - Denotes an honors level course in which students are expected to do independent work. The level implies acceleration as well as enrichment of the subject being studied.
6 - Denotes a regular level course. This level requires less independent study than levels 7 or 8, with less acceleration and enrichment. The subject is, however, studied in depth.
5 - Denotes a basic level available for students with serious weaknesses in any given subject area. This level is intended to give students a maximum opportunity for high school success.

Third Digit

1 - Represents first semester course content
2 - Represents second semester course content
3 - Represents first and second semester course content

COMPUTER COURSES
GLENBROOK NORTH HIGH SCHOOL
1985-86



COMPUTER SCIENCE 163
BASIC PROGRAMMING
2 SEMESTERS
PREREQUISITE: Concurrent enrollment in Algebra 163 or higher

COMPUTER SCIENCE 261
BASIC PROGRAMMING
1 SEMESTER
PREREQUISITE: Concurrent enrollment in Geometry 173, Algebra 263 or higher

COMPUTER APPLICATIONS 163
APPLICATIONS and PROGRAMMING
2 SEMESTERS
PREREQUISITE: Concurrent enrollment in Algebra G 161 or higher

BUSINESS
PROGRAMMING
161

COMPUTER SCIENCE 361
PASCAL PROGRAMMING
1 SEMESTER
PREREQUISITE: Successful completion of Computer Science 163 or Computer Science 261

BUSINESS
PROGRAMMING
161

COMPUTER SCIENCE 583
ADVANCED PLACEMENT
PROGRAMMING IN PASCAL
2 SEMESTERS
PREREQUISITE: Computer Science 361, Computer Science 471, or Computer Science 571

COMPUTER SCIENCE 471
ADVANCED PROGRAMMING IN
BASIC and FORTRAN
1 SEMESTER
PREREQUISITE: Computer Science 361

COMPUTER SCIENCE 571
MACRO ASSEMBLY LANGUAGE
PROGRAMMING
1 SEMESTER
PREREQUISITE: Computer Science 471

COMPUTER COURSES
GLENBROOK NORTH HIGH SCHOOL
1985-86

COMPUTER 153
APPLICATIONS and PROGRAMMING
2 SEMESTERS
PREREQUISITE: None, but typewriting recommended

BUSINESS DATA PROCESSING 161
INTRODUCTION TO BUSINESS/PERSONAL USE OF COMPUTERS
1 SEMESTER
PREREQUISITE: None, but Algebra 163 is recommended

↓

BUSINESS PROGRAMMING 161
COBOL PROGRAMMING
1 SEMESTER
PREREQUISITE: Data Processing 161, or another programming language course, or consent of department

COMPUTERIZED ACCOUNTING 161
COMPUTER APPLICATIONS IN ACCOUNTING
1 SEMESTER
PREREQUISITE: Accounting 163

COMPUTER COURSES

(Note: Computer courses do not meet mathematics or applied or fine arts requirements for graduation).

COMPUTER 153 GRADE: 9/10/11/12 LENGTH: 2 SEM. This is a two semester introductory computer course. Apple computers are used to teach lifetime computer skills. Units included are on the history of computers, impact of computers on society, the use of the keyboard, computer applications in various disciplines, simple BASIC commands, Apple applications for the home and business and limited programming. Prerequisite: None, but typewriting is helpful.

COMPUTER APPLICATIONS 163 GRADE: 9/10/11/12 LENGTH: 2 SEM. This course provides the student with general competency associated with software utilization on an Apple computer. Topics include such applications as word processing, data base mangement, spreadsheet, and related business materials. The development of simple programs using the languages of BASIC and LOGO are written to solve practical problems. This course is not intended for students who wish to take a formal "programming" course, but it could act as a stepping stone to further computer study. Prerequisite: Concurrent enrollment in or completion of Introduction Alg. G 161 or a higher level mathematics course.

COMPUTER SCIENCE (BASIC) 163 GRADE: 9/10/11/12 LENGTH: 1 SEM. This course teaches the basics of computer programming and related topics. Units included are on the history of computers, the impact of computers on society, computer assisted design on the Apple and basic programming on the Digital computer. Prerequisite: Concurrent enrollment in or completion of Algebra 163, a higher level math course, or Algebra 263S with math department recommendation.

COMPUTER SCIENCE (BASIC) 261 GRADE: 9/10/11/12 LENGTH: 2 SEM. This course teaches the basics of computer programming and related topics. Units included are on the history of computers, the impact of computers on society and programming in BASIC on the Digital computer. Prerequisite: Concurrent enrollment in Geometry 173, Algebra 263 or a higher level course with math department recommendation.

COMPUTER SCIENCE (PASCAL) 361 GRADE: 9/10/11/12 LENGTH: 1 SEM. The primary purpose of this course is to introduce the student to Pascal and to increase skills for developing strategies for solving problems with a computer. Individual problems requiring depth of understanding will be undertaken. Prerequisite: Computer Science 163 or 261.

COMPUTER SCIENCE (FORTRAN) 471 GRADE: 10/11/12 LENGTH: 1 SEM. This course is a continuation of Computer Science 361. The primary purpose is to expand the student's knowledge of fundamental algorithms used for most computer applications. The languages used are BASIC and FORTRAN. Prerequisite: Computer Science 361 and math department recommendation.

COMPUTER SCIENCE (MACRO) 571 GRADE: 10/11/12 LENGTH: 1 SEM. This course is a continuation of Computer Science 471. The primary purpose is to acquaint the students with MACRO in order to provide them with the experience of programming in an assembly language and to develop some basic skills in the area of programming. Prerequisite: Computer Science 471 and math department recommendation.

AP COMPUTER SCIENCE (PASCAL) 583 GRADE: 11/12 LENGTH: 2 SEM. This course is an advanced placement computer course which focuses on those topics that would normally comprise six or more semester hours of college level computer science coursework. The purpose is to teach the student how to write logically structured, well documented computer programs using PASCAL language. Treatments of computer systems and social implicators of computing are integrated into the course. All students are required to take the College Entrance Examination Board Placement Test as a condition for registration. High school credit for this course in no way assures college credit. Only students with the recommendation of the mathematics department are encouraged to take this course. Each student is required to pay the A.P. examination fee before the course commences. Prerequisite: Computer Science 361, 471 or 571.

COMPUTERIZED ACCOUNTING 261 GRADE: 11/12 LENGTH: 1 SEM. Students will complete the entire accounting cycle by utilizing prepared microcomputer software. Principles and concepts introduced in Accounting 163 will be reviewed. Students will use the computer to help analyze financial statements in order to make managerial decisions. This course will provide both the college-bound and career-oriented student realistic experiences in modern accounting methods. Prerequisite: Accounting 163.

BUSINESS DATA PROCESSING 161 GRADE: 10/11/12 LENGTH: 1 SEM. Students investigate types of data processing systems and equipment including micro and minicomputers.

Students study business applications and learn how the computer affects personal business recordkeeping as well as professional businesses. Various sizes of computers are compared and noted for advantages and disadvantages. Rules and concepts of the BASIC and COBOL programming languages are studied, compared and used to solve typical business problems (payroll, accounts receivable, checking account balancing, etc.). Prerequisite: None, but Algebra 163 is helpful.

BUSINESS PROGRAMMING (COBOL) 161 GRADE: 10/11/12 LENGTH: 1 SEM. Students become familiar with concepts of a modern digital computer system and its application to typical business problems. Rules and concepts of the COBOL programming language are studied and used to solve business problems which normally results in a printed managerial report (payroll summary of all employees, sales analysis of various salespersons, customer account balance information, etc.). The course is aimed for both the college-bound student who hopes to pursue a career in electronic data procesing and the student who hopes to pursue a career in programming immediately out of high school. Prerequisite: Data Processing 161, another programming language course, or consent of department.

Implementing Computer-Based Instruction

Not only is the description of resources and courses important in understanding how computers become an integral part of the educational process, but it is also critical to examine the process of actually implementing a general idea such as the use of computers as an "instructional tool." How is it successfully accomplished?

As is evident throughout this book, there are many different approaches that schools, departments and individual instructors have chosen to move the microcomputer into the classroom. Glenbrook North High School has chosen a "committee" approach. The committee currently has an operating budget of $60,000 per year with $18,000 per year set aside soley for equipment. The committee is responsible for deciding how that money is spent. Thus, all proposals for purchases, training seminars, etc. must be approved by the committee. The committee at Glenbrook North is not connected with one particular department but is a steering committee organized under the auspices of the Instructional Materials Center. Included on the committee are representatives from the IMC, business education, music, science, industrial education and math. (In contrast, Glenbrook South High School has the math department supervisor in the decision-making position.)

Three major decisions were made by the committee when it was first organized. The first area of concern involved the use of the mainframe computer, a Burroughs computer, for administrative purposes. With that computer, the payroll is processed along with scheduling, grading and student recordkeeping tasks. The second area of interest for the committee is in education and instruction on the minicomputer—the PDP 11/44 from Digital, along with 30 terminals. The third area of concern for the committee was, and is, the use of the microcomputers in the high school. Initially, that meant defining the use of eight computers and peripherals per high school. Now, the decisions regarding the microcomputers at North alone mean allocation of the equipment in two Apple Orchards (one with 22 Apple II+'s and one with 15 Apple IIe's), two rooms with Digital equipment and 30 terminals, and several Apples assigned to the IMC for the Resource Center. Other departments maintain computer equipment specifically assigned by the committe to that department, e.g., the IBM-PC is in the industrial education department for CAD instruction and dedicated word processors in the business education department.

The two main premises which direct the decisions of the committee are:

1) The computer is to be used as a learning tool.
2) Every student does NOT need to know how to program a computer to be considered computer literate.

The day-to-day work of the committee follows the chain of events described below. An instructor reads about a software package and/or hardware peripheral which s/he would like to use in his/her classroom. A request is made for approval to purchase it following a preview. This might involve looking at a piece of software or attending a conference where selection of CAD equipment is reviewed and discussed. Before asking for approval, the instructor has researched the product as much as possible. Once the software is received, it is sent to the IMC, catalogued and processed in the same manner as a book. It is stored in the IMC and available for checkout by any instructor or student in the school. The software and hardware belong to the school not to the individual departments, although they may be used exclusively by one department. The committee has been disappointed in several products they purchased, but in general they feel that the process is working.

Through the workings of the committee, microcomputers have been integrated into many curricula over the past five years. It should be noted that decisions are made within each department as to who uses the computer, when, and how. It is not up to the committe to schedule the day-to-day use of the machine once it is assigned to a specific department. A brief description by department follows:

Industrial Education

In industrial education they are using an Apple and have just purchased two IBM-PC's. They use the Apple to aid in the construction of a house that the students build every year. That involves the use of a heat loss program, materials costing program, etc. The IBM-PC's were purchased so that computer-aided drafting (CAD) could be added to the curriculum. The software that will be used is VersaCAD.

English

The English department uses three Apples. One is used basically as a word processor to write the school newspaper. Another is used by the reading and English teacher as a Second Language Program. Tutorials and drill-and-practice software are being used. The third is used by the Chapter I program for adjunct instruction.

Science

The science department uses the computer in the labs, both as a device for presenting simulations and as a record-keeping device. The physics and chemistry areas make the most use of the computer.

Music

The advanced placement music course uses 8-10 programs which focus on composition, tones, timing and developing computer-based music in the lab. The equipment consists of a keyboard attached to an Apple.

Home Economics

This department uses the computer with the preschoolers who are enrolled in the child development program. It is used to teach basic letter and number concepts. It is also being used in nutrition courses to analyze diet and nutritional needs.

Special Education

The special education teachers have just received a computer and are beginning to use drill and practice and tutorial packages with their students. They are a group who did not have any experience with computers so they have been attending inservices and have just begun to use the microcomputer to supplement their instruction.

Physical Education

The physical education and athletics departments are using the computer for administrative purposes such as scheduling sporting events, maintaining scores and records, and performing statistical analyses on the data collected during athletic events. They are also using the computer in a biofeedback program.

Business Education

The business education department has been using microcomputers in their courses for a number of years. Computers are used to both familiarize students with "job tools" and to assist in the instruction of business-related concepts.

In fact, one instructor took a sabbatical last year to research the software that was available for business education applications. It is to be noted that this department also has access to three AB Dick dedicated word processors along with many electronic typewriters.

Microcomputers are not used in the notehand course but are used extensively in all typing courses. Work includes a week-long unit for keyboarding on Apples, use of the program "Bank Street Writer," and programs such as "Typing Tutor." Time is also spend on the word processors. Each year, the instructors feel that more and more student keyboarding time is needed on a variety of equipment. There is a limited number of dedicated word processors, so students complete projects on the electronic typewriters, microcomputers and dedicated word procesors on a rotating basis.

Course by course, the microcomputers are used in the following ways:

> Accounting 163 This course provides an introduction to the use of microcomputers, including the use of systems flowcharts in accounting applications. Not only are capabilities of the microcomputer introduced to the students but computer programs have been adapted for review at the end of each unit of instruction in a drill and practice format.
>
> (It should be noted that an Advanced Computerized Accounting Course has just been added to the curriculum. See the list of courses on page 148 for a description of that course.)

Business English 161 This course is designed for students who want intensive instruction in speaking, writing, listening and punctuating. Course work includes training and practice in solving problems by letter writing. The AB Dick dedicated word processors are used in this class to complete projects. "Bank Street Writer" has also been used in this course to teach word processing as a tool to complete letter writing projects.

Business Law 161 and 261 Software has recently been examined for use in this course, especially the program, "Trial By Jury." In the future, there will be units of work that will utilize the microcomputers.

Business Math 163 The computer is used for remedial work for low level students, i.e., drill and practice programs in math.

Business Programming (COBOL) 161 In this course, students become familiar with concepts of a modern digital computer system and its application to typical business problems. Rules and concepts of the COBOL programming language are studied and used to solve business problems, which normally result in a printed managerial report such as payroll summaries, sales analyses and account balance information. The Digital minicomputer is used in this course.

Business Data Processing 161 Students investigate types of data processing systems and equipment including micro and minicomputers. They use the Apple to learn BASIC and the Digital to learn the rules and concepts of COBOL as well as learning about working on a time/share system. Types of computers are compared and noted for advantages and disadvantages. The course focuses on the uses and capabilities of the computers and the ability of the computer to manipulate data, but not primarily to teach formal programming; mere AWARENESS of the variety of programs and languages.

Introduction to Business 163 This includes basic business information useful to all students. Basic economic theory, taxation, investing, banking services, credit and insurance are only a few of the topics covered. Several simulations packages, produced by Blue Chip Software Company in California, are used in the finance unit. For example, "The Millionaire" is used in the Finance and Computer Units. It teaches the student how to select and buy stock. The study plan used with this program follows.

> Millionaire is a venture into the world of stock market investing. The student will experience the involvement in high finance, while learning basic stock market terms, skills and concepts. Millionaire is based on actual stock market trends rather than on random numbers. At the onset of each game, the computer creates a new stock market environment. This environment consists of 91 weeks of stock market fluctuations. At the beginning of the game, the student is given 14 weeks of stock information and is ready to make his/her forture from the $10,000 and 15 actual stocks from five industry categories as investment possibilities. The student buys and sells in response to an array of influences on the market. Among these is a constant stream of news events based on incidents that have actually happened. The game expands to include such sophisticated features as buying-on-margin, call options and put options.

The following worksheet was created for the student to use with the software.

Name ______________________

COMPUTER WORKSHEET

1. You are presently at Week 14. Study the current market trend.

   Has the market average gone up or down this past week?______________

   What level is it at now? ______________

2. Study the graph of the industry which appears on your screen this week.

   Which industry is shown? ______________

   What level is it at now? ______________

3. Read The Financial Journal. (This is similar to the Wall Street Journal.)

   Choose at least one news article and summarize below.

   ____

   ____

   ____

   Of all the clues given in MILLIONAIRE, the news items are the most significant. You may want to record these items on a separate sheet of paper.

4. View the quotations on your screen. Record answers to the following questions.

   How many losers this week? ______________

   How many winners this week? ______________

   Has the market gained or lost points? ______________

   Which stock had the highest gain? (Look at net change and record such as this: SRS 1.25) ______________

   What was the highest closing price of any stock this week? ______________

5. You have $10,000 to spend. You may use any part of that money to buy stocks at this time.

6. After completing your purchases for this week, enter WEEK for action desired to advance to Week 15.

7. After you have viewed and studied all the screen information for Week 15 and have arrived at Menu Selection, enter GRAPH for desired action. Choose a company you would like to study and type in the number.

   Summarize the corporate history below.

   ____

   ____

   ____

   At what dollar value did this company close for Week 15? ____________

   Enter 22 to exit when you no longer desire to view more graphs.

8. Type in STOCK for desired action to display your stock portfolio. Select at least one of your companies and give the current position.

   ____

9. Key in SELL for desired action and follow given instructions to sell at least a portion of one or more of your stocks.

   How much was the commission for the sale of your stock? ____________

   Did you have a net profit or a net loss? ____________

   What is your current cash balance? ____________

   What is your net worth? ____________

10. Purchase more stocks at this time if you desire. Otherwise, advance to the next week.

11. Toward the end of the period:

    What stocks are listed in your portfolio and what are their positions?

    ____

    ____

    ____

    What is your current cash balance? ____________

    What is your net worth? ____________

12. Key in QUIT to end the game. Return the worksheet and disk to your teacher.

Prepared by Glenbrook North High School for Introduction to Business Classes.

Management and Marketing Classes Software has been ordered for these courses but, because the teachers have been somewhat reluctant to use microcomputers, the units have not yet been developed.

Office Practice 163 (soon to be called Word Processing) This course develops an awareness and understanding of changing technologies affecting the work environment and the way office workers are expected to function in that work environment. Areas of content include an introduction to word processing, machine transcription, and related skills; keyboarding on automated equipment; word processing simulation; word processing managment/supervision; and communication skills. Again, students are rotated among machines (dedicated word processors, electronic typewriters and microcomputers) to learn management-related activities, grammar, and communication skills.

Shorthand 163 The student learns the Gregg Shorthand Theory with an emphasis on accurate reading and writing of outlines. The dedicated word processor is used for transcription during selected units.

Teacher Training

There are approximately 200 faculty members at Glenbrook North High School. Approximately 175 have taken at least one computer literacy Inservice at the school (4-6 hours). It is purely an introduction to computers and is not mandatory. Some inservices have been conducted during Institute Days. They are taught in the labs by high school staff.

If a teacher wants more information about computer applications than is presented during Institute Day, "inservice training" is available through the school and is taught in the lab. These last from 8:00 a.m. to 2:00 p.m. during a school day. Substitute teachers are hired so that the faculty member may attend the course.

The third type of inservice activity provided by the school is a Saturday Intensive Training program. Staff are paid to come on that day. It focuses closely on specific software packages such as data base management programs, word processing and spreadsheet packages. Basically, the software is introduced and then used during the day. Again, this program is open to all faculty but each staff member needs approval from a department head to attend any of the programs.

It is hoped that through the inservice structure, all teachers will be introduced to a Gradebook Program which will eventually be used throughout the school. There is also money in the budget to send teachers to conferences and workshops outside the school for more advanced training.

The Future

Issues which Glenbrook North High School will be examining in the future include:

- The use of networking with the Corvus Hard Disk,
- Maintaining an equipment inventory on the mainframe computer,
- Transferring the IMC Media Catalogue onto the microcomputer,
- The future of the mainframe computer (e.g., in the library they would like to go on-line to automate circulation ordering but the old system does not have the capabilities to do that),
- The value of retaining COBOL in the curriculum,
- The value of retaining the digital computers, and
- Using the modem effectively in the library to access extensive database systems.

A COMPUTER LITERACY COURSE AT A LIBERAL ARTS COLLEGE

SCHOOL: Nebraska Western College
ADDRESS: 1601 W. 27th Street, Scottsbluff, Nebraska 69361
TELEPHONE NUMBER: (308)635-3606
INSTRUCTIONAL PROGRAM: Computer Literacy
CONTACT PERSON: K. Lee Maiwald, Business Administration/Data Processing

Nebraska Western College began using computers in their courses during the mid-seventies and has continued to develop new ways to integrate the computer into a variety of curricula. Using computers as an instructional tool became a structured objective in 1976 when two faculty members enrolled in a summer training program which focused on the uses of computers in education. The college initially used mainframe computers and then eventually switched over to the microcomputer for classroom use. With the mainframe, they were basically teaching "language" courses for the math and business departments. Once the use of computers as an educational tool became an accepted phenomena and microcomputers became affordable, a Committee of Computer Planners was established to make decisions concerning computer use throughout the math and business departments.

At about the same time, the Small College Business Consortium, a national professional group, was developing a conceptual framework to teach computer literacy as a way to instruct all students about the capabilities and applications of computers. Concurrently, the Nebraska Western College received a grant and used it to create an open laboratory of 55 IBM-PC's and Franklin's (with printers). In order to utilize the equipment with the most efficiency and effectiveness, they wanted to introduce a course designed around the conceptual framework advanced by the consortium. An "applications course" was developed, open to all students with no prerequisites. It was designed as a three-credit course to teach students how to use the computer through the use of three software packages: word processing, data base management, and spreadsheet analysis.

Faculty Training

A computer/resource person was employed by the school to coordinate computer services. Faculty training for those who wanted to use the lab was done independently; no structured program was made available except for several one-day inservice programs presented to the entire faculty. Despite the lack of formal inservice training, the faculty are programming software to fit their needs, modifying already existing software and using pre-packaged software.

The Curriculum

The computer literacy course is the only course offered at the College that is taught solely in the computer lab. Other courses use the lab for completing projects but do their actual teaching in a more traditional manner. During the literacy course, there is one student per machine. This course is only offered at one level. An advanced class is not included in the curriculum; however, if students want to take additional courses in a topic they can register for a professional level course such as Word Processing.

The curriculum is based on "contract study." Students have manuals and workbooks with which they independently work on their projects. There are some lectures which serve to introduce new concepts. The instructor is available to supervise work but students are expected to go through the manual and exercises on their own. Software used includes:

> *Word Star* for word processing;
> *Visicalc* for spreadsheet analysis; and
> *Technology Information Management* (TIM) for database management.

Textbooks are used to teach the use of TIM and Word Star. The teacher usually introduces the topic as a problem(s) and the student pursues information about the subject from the text and then completes the assigned problems. This "problem" approach, rather than the lecture approach, is critical to the success of the program, according to the instructors. Examples of textbooks used include a book entitled *Power of Visicalc, Volume 1 and Volume 2* (by William Taylor King, Management Information Source, Inc., Portland, Oregon).

Evaluation

Both students and instructors feel very positively about the literacy course. Student interest is high because the information is seen as valuable to their future employment. Students are more responsible for their work in the lab and seek each other's help more frequently. They are motivated and have taken a personal pride in their assignments. They consistently show more respect towards their teachers because they value the information being taught in the classroom. Formal evaluations have been completed and the enrollment figures continue to be high. Classrooms and labs are now used on Saturdays, for the first time, to cover the demand.

The biggest hurdle to making this program successful has been obtaining the equipment necessary to meet the needs. Faculty have not found any problems associated with the "process" of learning. The microcomputer has proven to be a motivating tool and a "different" way to learn. The problems are merely of a physical nature.

Maiwald feels that in evaluating the place of the microcomputer in instruction, it is important to keep in mind that it may not be particularly useful in classes where intense interaction between student and teacher is a necessary component of the learning process. When a microcomputer is being used, discussions between students and teachers are different than in a classroom where people are sitting face to face discussing issues and concepts.

Summary

In summary, Maiwald feels that the microcomputer has had a positive impact on education but warns others to be wary of software purchases. Each instructor usually has personal preferences as to the best software to use and should be given the opportunity to teach with the materials of his/her choice.

His maxim when buying equipment is, "Go for the best," meaning buy the machine with the most capabilities to handle the many software choices of all instructors. He has found that the IBM's are excellent for business applications and the Apple and Franklin are good for testing and non-business needs.

Most importantly, integrating the microcomputer into a curriculum is a new dimension of education and an area in which instructors need to become skilled and accepting of the ever-changing quality of the microcomputer. It demands a commitment of learning and exploration from the teacher before ongoing integration can be successful.

INTEGRATING THE MICROCOMPUTER
INTO A BUSINESS EDUCATION CURRICULUM

SCHOOL: Titusville Senior High School
ADDRESS: 302 East Walnut Street, Titusville, PA 16354-1998
TELEPHONE NUMBER: (814)827-9687
INSTRUCTIONAL PROGRAM: Business Education
CONTACT PERSON: Terry K. Stover, Chairperson

Titusville Senior High School's Business Education Department has integrated the microcomputer into several already-existing courses including accounting, typing, and machine transcription.

History

Microcomputers were first introduced into the business education curriculum in 1981. Because most of the funding for the microcomputers came from federal monies, the Business Education Department was required to have their Advisory Board play an integral role in all decisions made regarding their use. Represented on the Board, on a rotating basis, are owners of small businesses; hospital and bank executives; local executives; legal and medical secretaries; and management representatives from the community. The Board provides advice on "how to" integrate the computer component into the curriculum, and how to purchase the appropriate equipment. With the input from both the Advisory Board and the five faculty members in the Business Education Department, the role of microcomputers in the curriculum was defined and implemented.

The primary goal of the business education curriculum is to prepare workers to enter an occupation. Therefore, the skills that were to be taught, via the microcomputer, were those that employers wanted new employees to have. These included: 1) data entry skills, 2) word processing skills, and 3) skills in automated accounting.

After these three curriculum goals were defined, equipment was purchased. According to Terry Stover, Chairperson of the Department, the committee made the mistake of choosing hardware first and then searching for software which would do what they wanted on those particular machines. The department did eventually find adequate software but in retrospect, the process of attaining the equipment could have been simplified by first determining goals, then finding the software that could meet those goals, and finally buying the hardware which was compatible with the software.

The Business Education Department chose Radio Shack TRS-80 Model III's and Model IV's. The primary reason for choosing the hardware was proximity to the service center. Apples were also considered but Titusville, being a rural community, is 50 miles away from the nearest Apple service center. The TRS-80 service center is in a town near Titusville and provides quick and reliable service. Currently, there are four computers and two printers in the Business Education Department.

The first year that the computers were in the school, they were used to train faculty, not teach students. Inservice days were organized by the district to teach staff computer literacy skills. In addition, two business education faculty members attended summer workshops and Radio Shack training programs. The administration has always been very supportive of computer-related activities, both financially and otherwise.

The Curriculum

It is important to note that all students who are scheduled into the courses which use the microcomputers are seniors. Most have had some prior experience with computers. At Titusville Junior High School, all 9th graders are required to spend 18 weeks on the microcomputer in a computer literacy course which is taught by certified academic teachers. In the future, it is possible that a keyboarding course will be introduced into the Junior High School and taught at the same time so that students will learn the correct use of the keyboard the first time they use the computer.

Instead of creating new courses which focus solely on the use of the microcomputer in business education, the department decided to add the microcomputer component to already-existing courses. The computers are housed in a structured lab. Students work independently on projects under the teacher's direction. The lab is scheduled on a rotating basis. Each student has a number of weeks during which they have access to the microcomputer to complete projects. When they use the computer, there is one person per computer and one printer for every two computers.

The curricula in the courses which utilize the computer were restructured after the microcomputer became one of the teaching tools. In general, students first learn the basic knowledge and concepts taught in each course away from the computers and then use the computer as a capstone to that knowledge. The computer is thus defined as a job tool and is introduced to students after the basics are taught through a more traditional presentation.

The following pages illustrate the strategy used to integrate computers into the curriculum, in the two-year accounting sequence. The microcomputer is used the second semester of the senior year to teach automated accounting once procedures are mastered manually. Projects are assigned and completed in the lab. To teach this segment of the accounting course, the high school has purchased Automated Accounting for the Microcomputer from South-Western Publishing Company. A workbook and diskettes are included in the packet. The workbook takes the students through a number of projects which illustrate automated accounting.

The course descriptions, objectives, content, materials, evaluation procedures and the learning outcomes for each unit of study follow for the courses.

ACCOUNTING II

Course Description

The course is an elective primarily for Business Education seniors but open to any student who has obtained a final grade of "B" or better in Accounting I. The course is a one-credit course. It builds on the basic knowledge and skill learned in Accounting I and applies this knowledge to more detailed and complex problems.

Objectives

1. Given necessary problems, the students will complete a review of the basic principles of accounting.
2. Given instruction in departmental accounting, the student will record all necessary entries for a departmentalized business.
3. Given information about and instruction in preparing payroll records, the student will keep such records and realize the necessity of keeping detailed payroll records.

4. Given instruction and demonstration in calculating depreciation, the student will calculate depreciation using the common methods.

5. Given instruction, demonstration, and information about recording entries concerning depreciation and fixed assets, the student will keep such records.

6. Given information about depletion and wasting assets, the student will complete problems about these items.

7. Given information and instruction in handling bad debts, the student will work problems and make entries involving bad debts.

8. Given information and instruction on accruals, the student will make entries in the journal to adjust any accrued income and accrued expenses.

9. Given information and instruction on deferred charges and deferred credits, the student will make the necessary entries to adjust prepaid expenses and income collected in advance.

10. Given instruction and information about partnerships, the student will have general knowledge about the formation of a partnership, profits and losses of partnerships, and work at the end of the fiscal period for partnerships.

11. Given a practice set, the student will apply all accounting principles up to this point in successfully completing the set.

12. Given proper instruction, the student will learn the how and why of record control accounting and the use of the voucher system.

13. Given instruction, illustrations, and demonstrations, the student will solve problems of inventory control and valuation.

14. Given information, instruction, and illustrations in the use of notes receivable, notes payable, trade acceptances and drafts, the student will work various problems involving these papers and record the necessary transactions.

15. Through discussion, reading newspapers, and text material, students will be aware of the different career opportunities available.

16. Through discussion and example, the student will be able to identify and apply the twelve accepted accounting concepts.
17. Students will know the differences between manual and computerized accounting.
18. Students will understand the principles and practices of automated general ledger accounting.
19. Students will understand the principles and practices of automated accounting for accounts receivable, accounts payable, and payroll.

Content

1. Review the accounting cycle.
2. Accounting for a departmentalized business.
3. Payroll records and procedures.
4. Accounting for bad debts.
5. Accounting for depreciation of fixed assets.
6. Accounting for the disposition of fixed assets.
7. Accounting for depletion of wasting assets.
8. Adjusting entries for accrued income and accrued expenses.
9. Adjusting entries for prepaid expenses and income collected in advance.
10. Partnership accounting.
    a. Formation of a partnership.
    b. Profits and losses for a partnership.
    c. Worksheet for a partnership.
    d. End of period reports for a partnership.
11. Practice set on partnerships.
12. Accounting for inventory control and valuation.
13. Use of the voucher system.
14. Accounting for taxes.

15. Automated accounting for the microcomputer.
    - a. General ledger
    - b. Accounts Receivable
    - c. Accounts Payable
    - d. Payroll

Materials

Basic Text - *Century 21 Accounting, Advanced Course*, Third Edition, Swanson, Ross, Hanson, and Boynton.
South-Western Publishing Co.
Cincinnati, Ohio, 1983.

Supplementary Materials - Student's workbook for above text.
Simulated practice set.
Overhead transparencies.
Standardized objective tests.
Workbook - *Automated Accounting for the Microcomputer*, Allen and Klooster, South-Western Publishing Co.

Evaluation Procedures

1. Students will be assigned practice problems which will be used to determine areas of difficulty and review.

2. Quizzes will be given on each chapter to determine how well the material was learned.

3. Problem tests will be given to evaluate the ability of the students to apply concepts and principles to given situations.

4. Objective Unit Tests will be given to evaluate entire areas of study.

5. Grades are determined by assigning point values to various evaluation methods and accumulating points for each student. Ninety percent of total points will earn an "A"; eighty percent will earn a "B"; seventy percent will earn a "C"; sixty percent will earn a "D";and less than sixty percent will earn an "E."

LEARNING OUTCOMES

Grade 12

Course Accounting II

UNIT I REVIEW BASIC ACCOUNTING PROCEDURES

Level I The student will . . .

1. review basic principles of accounting
2. review source documents, journals, and ledgers
3. journalizing transactions
4. posting
5. making a worksheet with adjustments
6. review the income statement
7. review the capital statement
8. review the balance sheet
9. adjusting entries
10. closing entries
11. post closing trial balance
12. the above with 70% accuracy

Level II The student will . . .

1. complete all steps with 80% accuracy

Level III The student will . . .

1. complete all setps with 90% accuracy

Unit II DEPARTMENTAL ACCOUNTING AND SPECIAL JOURNALS

Level I The student will . . .

1. learn how to use the Departmental Purchases Journal
2. learn how to use the Purchases Returns and Allowance Journal
3. learn how to use the Departmental Cash Payments Journal
4. learn how to use the Petty Cash Fund
5. learn how to use the Departmental Sales Journal
6. learn how to use the Departmental Sales Returns and Allowance Journal
7. learn how to use the Cash Receipts Journal
8. learn how to make Departmental Statements
9. accomplish all the above steps with 70% accuracy

Level II   The student will . . .

1. complete all the above steps with 80% accuracy

Level III   The student will . . .

1. complete all the above steps with 90% accuracy

UNIT III PAYROLL ACCOUNTING

Level I   The student will . . .

1. learn basic method of paying employees
2. learn how to make payroll register
3. learn how to figure deductions
4. learn how to make individual earnings record
5. learn entries necessary for payrolls
6. learn various reports necessary for payroll
7. accomplish above with 70% accuracy

Level II   The student will . . .

1. complete all the above steps with 80% accuracy

Level III   The student will . . .

1. complete all the above steps with 90% accuracy

Unit IV UPDATING ACCOUNTS BY ADJUSTMENT

Level I   The student will . . .

1. learn how to adjust for bad debts
2. learn how to adjust for depreciation
3. learn how to adjust for depletion
4. learn how to adjust for accrued expenses
5. learn how to adjust for prepaid expenses
6. learn how to adjust for accrued income
7. learn how to adjust for income received in advance
8. accomplish the above with 70% accuracy

Level II   The student will . . .

1. complete all the above steps with 80% accuracy

Level III   The student will . . .

1. complete all the above steps with 90% accuracy

UNIT V PARTNERSHIP ACCOUNTING

Level I The student will . . .

1. learn how to form a partnership
2. learn how to divide profits and losses
3. learn how to do the end of the fiscal period work for a partnership
4. accomplish the above with 70% accuracy

Level II The student will . . .

1. complete the above steps with 80% accuracy

Level III The student will . . .

1. complete all the above steps with 90% accuracy

UNIT VI AUTOMATED ACCOUNTING FOR THE MICROCOMPUTER

Level I The student will . . .

1. learn the difference between manual and computer accounting
2. learn how to care for diskettes
3. learn how to interpret a system flow chart
4. understand automated general ledger accounting principles and practices
5. learn the operational procedures of running an automated general ledger system
6. understand automated accounts payable accounting principles and practices
7. learn the operational procedures of running an automated accounts payable system
8. understand automated accounts receivable accounting principles and practices
9. learn the operational procedures of running an automated accounts receivable system
10. understand automated payroll accounting principles and practices
11. learn the operational procedures of running a payroll system

Level II The student will . . .

1. apply manual accounts payable accounting concepts and principles to an automated accounts payable system
2. apply manual general ledger accounting concepts and principles to an automated general ledger system

3. apply manual accounts receivable accounting concepts and principles to an automated accounts receivable system
4. apply manual payroll accounting concepts and principles to an automated payroll system

Level III The student will . . .

1. solve automated general ledger problems for businesses organized as sole proprietorship and partnerhsip
2. solve automated accounts payable problems for various businesses
3. solve automated accounts receivable problems for various businesses
4. solve automated payroll problems for various businesses

During the senior year, business education majors can choose to take a course on production typing. Data entry is one nine-week component of this course. The materials used to teach data entry are also published by South-Western Publishing: Data Entry Activities for the Microcomputer (contains diskettes and a project-oriented workbook for students to complete).

TYPEWRITING (SIMULATED PRODUCTION)

Course Description

Simulated Production Typing is for the third year advanced typing students taken in their senior year. The students work using a different company practice set every nine weeks. One set is to be completed each nine weeks and four sets for the year, one of which is done using the microcomputer. The course is established to represent actual office situations. Students progress at their own pace taking breaks as needed. They are responsible to the "Boss"—the teachers in charge. The course is designed to be team taught. Most students will type letters, invoices, memos, agendas, forms, purchase orders, legal documents, legal forms, medical forms, records, and other items. Data entry skills on the microcomputer are also developed along with word processing skills, since computers will be an important part of the student's future work experience. The course is one credit in value. To take the course, the student must have had a final grade of "C" or better in Typing II.

Behavioral Objectives and Content

A. The Medical Secretary - Given proper forms, materials, and instructions, the student will correctly perform the following activities:

1. Correctly file all forms
2. Determine priorities of assignments
3. Open patient files
4. Correctly keep an appointment book
5. Set up daily list of appointments
6. Record telephone messages
7. Give telephone prescriptions
8. Do Pegboard Accounting
    a. Patient charge slip
    b. Ledger sheet
    c. Daily log
    d. Complete financial records
9. Write checks
10. Fill out Blue Cross/Blue Shield insurance forms
11. Fill out Medicare and Worker's Compensation insurance forms
12. Record patient case histories
13. Correctly make discharge summaries
14. Type mailable letters, interoffice memos, speeches and purchase orders
15. Type accurate travel expense statements
16. Develop the skills and abilities required of a medical secretary:
    a. Good typing skills
    b. Knowledge of medical terminology
    c. Proficiency in proofreading
    d. Good human relation skills
    e. Confidentiality
    f. Ability to organize

B. Receptionist - Given proper forms, materials and instructions, the student will correctly perform the following activities:

1. Correctly distribute and file forms
2. Determine priorities of assignments
3. Type tour information forms
4. Type interoffice memorandums
5. Keep accurate appointment and schedule calendars
6. Fill out dispatch slips and telephone messages
7. Develop mini-bank reports
8. Keep accurate records of utility payments
9. Fill out deposit tickets
10. Write and type trading post column
11. Type mailable letters and envelopes

12. Work for promotions
13. Keep promotion tally sheets
14. Type promotion daily summary reports
15. Keep recap report
16. Type promotion inventory control sheets
17. Type news releases
18. Develop the following personal qualities and skills necessary for a receptionist
    a. Genuine interest in people and a desire to help with problems
    b. Project good company image
    c. Develop objectivity - putting things in proper perspective
    d. Develop good communication skills
    e. Perform various clerical duties

C. The Legal Secretary - Given proper forms, materials and instructions, the student will correctly perform the following activities:

1. General Office Procedures
    a. Filing all forms
    b. Determining priorities of work
    c. Keeping client records
    d. Typing appointment calendar
    e. Typing mailable letters and envelopes
    f. Have knowledge of proofreader's marks
    g. Complete time and cost recordkeeping
2. Preparing Legal Papers Accurately
    a. Typing legal documents
    b. Completing preprinted forms
    c. Typing the acknowledgments and verifications
    d. Preparing legal backs
    e. Conforming documents
3. Preparing Legal Papers Accurately
    a. Litigation (Court) Documents
        1. Complaint and summons
        2. Interrogatories
        3. Answer
        4. Subpoena
    b. Legal Instruments
        1. Affidavit
        2. Contracts and agreements
        3. Deeds
        4. Power of attorney
        5. Wills
4. Develop skills, abilities and duties required of Legal Secretaries
    a. Good typist
    b. Good transcriber

    c. Follow explicit instructions and use references
    d. Project an image of competence, dependability and confidentiality
    e. Keep all matters confidential
    f. Learn all terminology

D. The Clerk-Typist - Given proper forms, materials and instructions, the student will correctly perform the following activities:

1. File all forms accurately
2. Determine priorities of assignments
3. Type credit memos accurately
4. Type customer orders accurately
5. Type invoices accurately
6. Make up duplicating requests
7. Type mailable letters and envelopes
8. Type accurate interoffice memos
9. Set up message forms
10. Type mailable purchase requisitions
11. Type mailable purchase orders
12. Type accurate sales representatives commission reports
13. Type transmittal slips accurately
14. Keep up-to-date customer card file
15. Keep accurate vendor card file
16. Keep current and up-to-date price list
17. Develop the skills, abilities, and duties required of clerk typists
    a. Good typing skill
    b. Knowledge of filing, operate business machines, and answer telephone properly
    c. Good communication skills
    d. Be able to organize, make decisions, and set priorities
    e. Have regular attendance, promptness, initiative, interest and pride in work, common sense, and dependability

E. Broadcasting Secretary - Given proper forms, materials and instructions, the student will correctly perform the following activities:

1. Correctly fill out an application for employment
2. Type mailable memorandums
3. Type mailable letters and envelopes
4. Type accurate press releases
5. Type transportation requisition and voucher
6. Type a budget accurately
7. Type payroll authorization
8. Type typing request

9. Type accurate acronyms
10. Type condensed telephone instructions
11. Type and learn glossary of broadcasting
12. Type remote production memorandums
13. Type accurate advertising orders
14. Type individual request for broadcast tickets
15. Type messenger service requisitions
16. Type authority for payment forms
17. Type broadcast schedules
18. Type accurate travel expense vouchers
19. Type mailable supply requisitions
20. Type an accurate information and services paper

F. Typist in an Amusement Park - Given proper forms, materials and instructions, the student will correctly perform the following activities:

1. Type accurate address cards
2. Type accurate agenda and agreements
3. Fill out employee information cards
4. Type mailable letters and envelopes
5. Type file folder labels and graphs
6. Fill out injury reports and insurance claims
7. Type mailable memorandums
8. Type accurate itinerary
9. Type meeting summary and news releases
10. Gain thorough knowledge of proofreader's marks and galley
11. Type accurate purchase orders, reports and manuscripts
12. Set up tables and side tabulation
13. Learn the correct way to sign requests
14. Type transmittal slips
15. Type accurate travel expenses report and voucher checks
16. Develop skills, abilities, and duties required of the company
17. Produce copy that is neat, attractive, and error free

G. Insurance Clerk - Given proper forms, materials, and instructions, the student will correctly perform the following activities:

1. Type vehicle premium invoices
2. Complete vehicle rating worksheets
3. Type reports in outline style
4. Type mailable letters and envelopes
5. Handle routine correspondence
6. Type notices of cancellation
7. Type reports in tabulated form
8. Type ID index cards

9. Type accident statements
10. Keep accurate entries in the receipt and payment journal
11. Type checks (voucher checks)
12. Type insurance applications
13. Type reports in paragraph style
14. Type memorandums
15. Type reminder notices
16. Type homeowner's premium invoices
17. Complete payment receipts
18. Type and prepare a card index file
19. Accounts receivable folder should be kept
20. Correspondence folder should be kept

H. Understanding Others - Given the opportunity to work with others in an office-type atmosphere, the student will exhibit the ability to work with and appreciate the worth of all people.

I. Data Entry Activities - Given the proper direction, demonstrations, and materials, the student will correctly input data and print out data using the microcomputer for the following activities:

1. Mailing list
2. Merchandise inventory
3. Accounts receivable invoices
4. Accounts payable invoices
5. Bank reconciliation
6. Payroll (4 types)
7. General ledger
8. Word processing of letters
9. Word processing of reports

NOTE: The company simulations made available to the students may vary from year to year, depending on the employment projections and needs within the school community.

Materials

1. Atkinson, Phillip S. Typewriting Office Practice - Liberty Broadcasting Company, Sixth Edition. South-Western Publishing Co., 1980.

2. Butler, Tommie and Phyllis Smith. People's Trust of Little Rock - Receptionist. South-Western Publishing Co., 1978.

3. Holmes, Ralph M. Pleasure Island - A Typewriting Simulation. Houghton Mifflin Company, 1979.

4. Humphrey, Doris D. Northside Medical Center, P.C. - The Medical Secretary - An Office Job Simulation. South-Western Publishing Co., 1980.

5. McIntosh, Harriett, and Clyde Wetter. Freeman, Rosa & Arnold - The Legal Secretary - An Office Job Simulation. South-Western Publishing Company, 1977.

6. Shinn, Larry. Indio Paper Company, Inc. - The Clerk-Typist - An Office Job Simulation. South-Western Publishing Company, 1974.

7. Bulletin Boards

8. Cassette Tapes

9. Ellis, Kaethe. The Word Book - Dictionary, Houghton Mifflin, Boston, 1976.

10. Foss, Ervina E. and Sherwood, Doris N. Webster's Medical Speller. G & C Merriam Company, 1975.

11. A. Merriam Webster. Webster's Legal Speller. G & C Merriam Co., 1975.

12. Data Entry Activities for the Microcomputer; Bux & Clark; South-Western; 1982.

13. SuperScripsit; Radio Shack; 1980.

14. Other Simulation Projects as selected based on individual student interest and/or need.

Evaluation Procedures

1. All correspondence must be totally mailable.

2. All other typing, mathematical figuring, and composition is to be evaluated for 100 percent accuracy.

3. Grading scales used are those found in the teacher's manual for each simulation. Microcomputer projects are evaluated for correct data and format.

The grading scale for the semester and final grade:

A = 3.5-4   B = 2.5-3.49   C = 1.5-2.49   D = 1-1.49

LEARNING OUTCOMES

Grade 12

Course Simulated Production Typing

Note: There are six units, each unit designed to simulate the work found in a particular type of business. Each student must select and complete a minimum of four—one for each grading period.

UNIT I THE CLERK TYPIST/INDIA PAPER CO., INC.

Level I The student will . . .

1. complete all work assignments in nine weeks on a "correctable" level with a minimum of teacher assistance
2. type and complete the following work assignments: form letters, envelopes, duplication requests, spirit masters, stencils, purchase orders, memorandums, transmittal slips, invoices, credit memo, odd size paper projects, sales representative reports, name and address directory, original letters, original compositions, index cards, and prepare materials as recorded on a transcriber

Level II The student will . . .

1. complete all assignments on a "mailable" level within nine weeks
2. develop an understanding for setting priorities for organizing work assigned

Level III The student will . . .

1. complete all assignments on a "mailable" level in less than nine weeks

UNIT II THE RECEPTIONIST/PEOPLE'S TRUST OF LITTLE ROCK

Level I The student will . . .

1. complete all work assignments in nine weeks on a "correctable" level with a minimum of teacher assistance
2. type and complete or write and complete the following work assignments: interoffice memorandum, tabulated report, dispatch slips, receipts of payment, summary reports, deposit slips, block style letters, envelopes, tele-

phone response sheet, news release, referral sheet, daily summary report, daily tally sheet, receptionist response sheet, column forms, and donation tally sheets

Level II The student will . . .

1. complete all assignments on a "mailable" level within nine weeks
2. learn banking terminology needed by bank employees with 95% accuracy

Level III The student will . . .

1. complete all assignments on a "mailable" level in less than nine weeks

UNIT III GENERAL OFFICE/PLEASURE ISLAND AMUSEMENT PARK

Level I The student will . . .

1. complete all work assignments in nine weeks on a "correctable" level with a minimum of teacher assistance
2. type and complete the following work assignments: employee information card, employment information sheet, memo, news article, table, letters, envelopes, agenda, policy manual, organizational chart, address cards, file folder labels, menus, purchase orders, sign request, meeting summary, magazine article, graph, program, itinerary, agreement, ride tabulation form, galley proof, preparation of *The Passport*, injury report, voucher check, and expense reports

Level II The student will . . .

1. complete all assignments on a "mailable" level within nine weeks
2. learn to set priorities for work assignments

Level III The student will . . .

1. complete all assignments on a "mailable" level in less than nine weeks

UNIT IV CLERK TYPIST/LIBERTY BROADCASTING CO.

Level I The student will . . .

1. complete all work assignments in nine weeks on a "correctable" level with a minimum of teacher assistance
2. type and complete the following work assignments: application for employment, minutes of meeting, movie schedule, memorandums, letters, envelopes, press releases, announcements, tables, requisitions, vouchers, budget, reports, payroll authorization, manuscripts, payroll deductions plan, advertising order, requests, responses to requests, file folder labels, authority for payment, broadcast schedule, relocation announcement, tabulated lists, and rating charts

Level II The student will . . .

1. complete all assignments on a "mailable" level within nine weeks
2. develop an understanding of an importance of "deadlines"

Level III The student will . . .

1. complete all assignments on a "mailable" level in less than nine weeks

UNIT V MEDICAL SECRETARY/NORTHSIDE MEDICAL CENTER, P.C.

Level I The student will . . .

1. complete all work assignments in nine weeks on a "correctable" level with a minimum of teacher assistance
2. type, record and/or complete the following work assignments: letters, envelopes, memorandums, insurance forms, patient case histories, transcribe from rough-draft copy, type from machine dictation, index cards, patient files, daily log, charge slips, expense statements, discharge summary forms, telephone messages, ledger sheets, appointment lists
3. develop an understanding of general medical terminology and use these words properly
4. develop an understanding for confidentiality and ability to organize work assignments
5. understand the basic filing systems used in an office

Level II The student will . . .

1. complete all correspondence on a "mailable" level, and other prepared materials with 95% accuracy, in nine weeks

Level III The student will . . .

1. complete all assignments on a "mailable" level and other prepared materials with 100% accuracy in less than nine weeks

UNIT VI LEGAL SECRETARY/FREEMAN, ROSA & ARNOLD

Level I The student will . . .

1. complete all work on a "correctable" level with a minimum of teacher assistance
2. type, record and/or complete the following work assignments: court papers, legal instruments, preprinted legal forms, legal backs, office and legal correspondence, composing of routine letters, opening client files, posting to ledger sheets, statements, filing and retrieving, transcribing recorded material, doing final copies from rough drafts
3. develop an understanding of the special characteristics of legal office work and the legal terminology needed for employment
4. develop an understanding for confidentiality and ability to organize work assignments

Level II The student will . . .

1. complete all correspondence and all other documents and work assigned with 100% accuracy in nine weeks

Level III The student will . . .

1. complete all assignments with 100% accuracy in less than nine weeks

UNIT VII INSURANCE CLERK

Level I The student will . . .

1. complete all work on a "correctable" level with a minimum of teacher assistance

2. type, record and/or complete the following work assignments: vehicle premium invoices, vehicle rating worksheets, reports in outline form, mailable letters and envelopes, routine correspondence, notices of cancellation, reports in tabulated forms, ID index cards, accident statements, receipts and payment journals, voucher checks, insurance applications, reports in paragraph style, memorandums, reminder notices, homeowner's premium notices, payment receipts, card index file, and work folders
3. develop an understanding of the special characteristics of insurance office work and the terminology needed for such employment
4. develop an understanding for confidentiality and ability to organize work assignments

Level II The student will . . .

1. complete all correspondence and all other documents and work assigned with 100% accuracy in nine weeks

Level III The student will . . .

1. complete all assignments with 100% accuracy in less than nine weeks

The third set of courses which use the microcomputers are Machine Transcription and Typing II. In these courses, the microcomputer is used to teach word processing with SuperScripsit, developed by Radio Shack. Instead of a workbook, the instructor teaches the students through the manual and provides projects and activities for them to complete.

The Future

Eventually, SuperScripsit will also be used in the Business English class. The faculty also hope to find a way to give all secretarial students more time on the computer. At this time, facilities are too limited.

The microcomputer is also being used for those students who enter a course late in the school year and need to catch up to the rest of the class. Software such as Typing Tutor, a drill and practice program which teaches typing skills, has been used by new students and those that need remedial work. The faculty has found that in using these programs as such, reading skills are also improved because of the immediate reinforcement for spelling and concomitantly in reading. This relationship has not been formally tested but it is a relationship that has been consistently observed by the instructors.

If a student wants to learn programming skills, in addition to those skills taught by the business education faculty, they are directed to take a programming course in the math department where there is another computer center. In that center, there are 27 Radio Shack microcomputers.

Evaluation

Evaluation has been informal, to date. Comments from employers in the Coop Program and students have been very positive. Employers want their employees to be familiar with the computer and its capabilities. They want students to attain skills in data entry and word processing, and be flexible enough to be retrained on parallel equipment.

Faculty members have observed that students are much more motivated than they were when learning in a more traditional learning environment. Animosity has been reduced between the teacher, who is often seen as an authority figure, and the students because the information is more interesting when the project can be completed on the microcomputer. Because class work is more project-oriented, the classroom seems more like a typical employment situation; projects are assigned and supervised by the teacher who assumes the role of "employer."

It has also been noted that there is reduced absenteeism when a student is on the computer rotation. Enrollment in the classes which utilize the microcomputer have increased because students are interested in the work that they complete on the microcomputer.

The way students relate to each other has also changed. There is now a team effort in the classroom. Students are interacting over projects such as Payroll Comparisons, always a very dry and boring subject when taught from a textbook.

Summary

In summary, the introduction of the microcomputer into the curriculum has been a very positive experience for this business education department. The biggest problem that the faculty has encountered is finding software. Companies promise products that are not yet developed. This makes financial planning difficult.

The other concern of the business education faculty is inventory. It is difficult to expand the use of the microcomputer to other components of the curriculum with the limited equipment available. Scheduling machine usage and managing rotations is already a big problem.

Another problem which arises every semester is encouraging those students who have a strong fear of computers to use them. It is a constant struggle to get these students to feel comfortable on the computers.

Mr. Stover suggests that when starting a program, it is first important to determine what job-related competencies are important to the community's employers. Teachers need to spend their time instructing students in those specific competencies. Software should then be chosen which teaches those competencies. Finally, hardware should be purchased. Although the hardware and software chosen do not necessarily need to be the same as the systems owned by area employers, it does need to be capable of teaching the skills and supporting the competencies that students will need to perform when they are employed.

SIMULATION OF A MODEL OFFICE

SCHOOL: East Central Multi-District Vocational School
ADDRESS: 700 Elm Avenue Brookings, SD 57006
TELEPHONE NUMBER: (605)692-9737
INSTRUCTIONAL PROGRAM: Business Education
CONTACT PERSON: Les Kor, Model Office Instructor

An exemplary program for microcomputer operations was funded by the state of South Dakota which enabled business teachers in the state to integrate microcomputer-based training into a Model Office program. The purpose of the program is to institute the use of computers in the model office and, at the same time, give students the skills and information to compete in the world of work. Within the project, new curriculum materials were developed which are used on equipment chosen to better acquaint students with the business world and the role of technology in the office.

Each year 60 students of all ability levels, including those with special needs and the handicapped, are served by this project. The students are juniors and seniors from four area high schools: Brookings High School, Deubrook High School, Flandreau High School and Sioux Valley High School—all members of the East Central Multi-District Vocational School. Students admitted to the program are screened by their high schools. Only those interested in office-related careers are admitted to the program. There is one prerequisite for the course—completion of a typing course. Currently there are 48 females and 5 males the program.

The participating high schools teach Computer Programming in a traditional manner but this program is unique in that it was designed to teach computer operations from the business standpoint through the use of "Model Office Simulations."

Being involved in the Model Office program is a year-long commitment for two hours a day. The remainder of the day is spent at the high school. Currently, there are 53 students enrolled in the program. There are three sections per day, meaning that 18 students are generally working together at the same time.

Equipment

There are two Apple IIe computers in the Model Office; each with a printer and two drives. No extra peripherals are used. Equipment is designed in an L-shaped format so that students in a wheelchair or those that are physically disabled will have access to the computer stations.

The Curriculum

Presently, the curriculum consists of 11 units of instruction developed for "pre-simulation" training. These include:

Typing
Calculating
Ditto Duplication
Thermofax Duplication
Mimeograph Duplication
Photo Copy Duplication
Filing
Payroll
Transcribing Machine
Memory Typewriter

The 12th unit focuses on Computer Operations and serves to tie the 11 units of instruction together during a structured simulation. This final unit teaches the students how to use the computer to perform many office-related tasks while giving them the training necessary to prepare for future occupations.

The program also aims to expand students' perceptions of work options in computer-oriented occupations and career opportunities, and assist in the development of educational plans for males and females.

Student objectives are based on inventories of tasks related to the use of a computer in a simulated office. These objectives (tasks) are to:

1. Institute the use of computers in the Model Office to enhance the total curriculum.
2. Better acquaint students with the business world.
3. Provide positive educational experiences to encourage and motivate students to continue their education.
4. Make students better consumers of business services.
5. Guide students into positions, occupations, and training programs for further education.

The curriculum outline for Unit 12 follows.

Instructional Objectives

Performance: The students will be able to put prepared programs into the computer. S/he will be able to record data of various types.

Time: To be completed in five class days

Materials, Equipment and Supplies Needed:

1. Microcomputer
2. Video Display Screen
3. Printer
4. Two Disk Drive Units
5. Two Diskettes
6. Student Data Sheet Information

Performance Required:

1. Put prepared program into the computer
2. Record data from employee sheets
3. Prepare printout of employee records

Evaluation:

1. Knowledge of using prepared program	40 points
2. Accuracy of recording data	20 points
3. Knowledge of printout material	40 points
Total Points	100 points

Student Directions:

1. Secure instruction manual of microcomputer operations.
2. Follow program step by step through use of flow charting.
3. Familiarize yourself with microcomputer capabilities.

A. Goals:

1) To instruct the student in the proper procedure involved with business usage of prepared programs.
2) To acquaint students with microcomputer capabilities.
3) To develop interest in a computer science career.

B. Objective:

1) To be able to put prepared programs into a microcomputer and record data with a degree of competency acceptable by businesses.

C. Duties:

1) Record data on employee files and tax data.
2) Record up to three company deductions and special individual employee deductions.
3) Calculate earnings.
4) Calculate FICA, Federal Income Tax Withholding.
5) Print a payroll register and individual earnings record.
6) Print checks.
7) Prepare W-2 forms for each employee.
8) Maintain and update mailing list information.
9) Maintain inventory control in the Model Office.
10) Maintain and control a list of company billing data.
11) Record data to prepare an amortization schedule for building and equipment payment in the Office.
12) Record weekly regional clerk data to aid in preparation of monthly reports.
13) Record employee deposits in APEX Company Bank and maintain accounts payable ledger.
14) Prepare and print monthly bank statements for company and employees.

D. The Computer Operator's duty will be to record all the above-mentioned data on the computer. The variable information will be submitted on special forms by the departments in the Model Office.

The above outline contains the goals and objectives of the program but how are these ideas implemented in the Model Office? As mentioned, the last unit of instruction in the course is in the Model Office. This lasts for 18 weeks. Students rotate on the computer during the Model Office Simulation as one of the many jobs in an office, including jobs which are not computer-based such as Receptionist and Typist. One job in the Model Office is the Word Processor position. The students at that station need to complete all their tasks on the Apple IIe using Apple Writer software. Another computer-oriented position in the Office is that of Computer Operator. This involves job tasks related to payroll, accounting, rebilling and inventory. All tasks are completed on an Apple IIe using MECC-MICAS software, software written by the instructor, and an inventory program called Incon-Borven (BORVEN Computer Service in Madison, Minnesota).

For each "job" position, the instructor has written a manual for the student to follow while under the supervision of the lead instructor. The number of work positions in the Model Office can vary from 10-25. Work is initiated by the instructor and flows from one department (student) to the next. A test is given at each station. For example, at the Word Processor station, a competency based test is given, in addition to completion of projects at that station.

The last five weeks of the school year, students work in an on-the-job training capacity in local businesses. Approximately 60-75% of the businesses have a computer in their office. The number is increasing every year.

For many students, the opportunity to work and learn in the Model Office is the first step in an office-oriented education. Only

20% of the students are directly employed after graduating from high school. The other 80% continue their education; 45% at the college level, and 35% at the post-secondary vocational level.

The Model Office facility is also being used in the Adult Education courses during night hours. Adults, who are returning to school for office retraining in a specific area, list their needs and then work on the computers and in the Model Office on tasks which parallel the activities of the full-time traditional students. They use the word processing and accounting software, following the same "work flow" process as the high school students.

Evaluation

Since the Model Office program is an exemplary program, it is constantly being evaluated by both the district and others around the state. It has been named the Outstanding Secondary Program in South Dakota, and has been submitted as an exemplary program from South Dakota to the regional evaluation committee.

The Future

The Model Office program has been very well-received by students, educators, and employers. In the future, they hope to expand to other computers, such as the Epson for word processing, which is more user-friendly than Apple Writer, and an IBM-PC which would enable the students to also learn how graphics are used in office-related work. In general, expansion will first involve finding quality software and then purchasing the hardware to go with it.

INTEGRATING INFORMATION PROCESSING INTO A BUSINESS CURRICULUM

SCHOOL: Murray State University, Department of Office
Administration and Business Education
ADDRESS: Murray, Kentucky 42071
TELEPHONE NUMBER: (502)762-4185
INSTRUCTIONAL PROGRAM: Business Education and Office Administration
CONTACT PERSON: Buddy Krizan

"Introduction to Information Processing," Office Administration Course #120, was added to the curriculum at Murray State University for the sole purpose of teaching business students how to use a microcomputer. Instructors in the department wanted to integrate the microcomputer into other higher level courses in the curriculum but did not want to use class time to teach students how to handle a diskette, turn on a computer, etc. Consequently, the departmental plan to use the microcomputer as an instructional tool included the establishment of an introductory course to alleviate the burden of repeatedly teaching students the fundamentals needed to utilize the capabilities of a microcomputer. In the introductory course, Literacy, Word Processing, Spreadsheet Analysis, Accounting, and Database Management programs are taught so that students will understand the capabilities and limitations of the microcomputer in the world of business. One hundred percent of the time in the course is spent at the microcomputer in a laboratory setting.

In this instance, integration of the microcomputer was best accomplished in several steps. The first step involved creation of a literacy-type course so that integration of the microcomputer into other already-existing curricula was not hampered by student illiteracy. That course, the first step for integrating the microcomputer, is described in this profile.

Facilities

The microcomputer lab in the Business College was established in May, 1983. There are 25 IBM-PC's (each with two drives that are single sided) and three printers in the lab. The decision was made to purchase the same kind of computer throughout the Business College because with one brand, it is easier to teach students, train faculty, and purchase software.

Decisions about equipment purchases are made by the Dean of the College, with input from the faculty. An external advisory committee is not used. The Dean made the final decision to buy IBM computers for the lab. Difficulty with servicing the microcomputers, however, arose because Murray State is located far from a service center. To alleviate that problem, a technician was hired by the Dean as a full-time employee of Murray State. When the lab does expand, more IBM's will be purchased although they are more likely to acquire advanced units such as the XT's.

The only problem Krizan foresees using the IBM computer is that the public schools in the state that employ their graduates own Apple's and/or TRS-80's. Students who learn on the IBM must also be taught flexibility in their approach to microcomputers in order to make an easy switch to a different keyboard, control keys, etc. To date, students who have been hired at schools with computers other than the IBM have not considered this a serious problem.

Course Content - Office Administration #120
"Introduction to Information Processing"

The first two weeks of the course focus on computer literacy. Half of each class period is structured around a lecture format, focusing on an orientation to the computer. The other half of the period is spent working on the software package, INSTRUCTOR. The students complete this as an in-class assignment and homework. The tutorial explains how the computer operates, the use of function keys, the capabilities of peripherals, etc. At the end of the two week block, there is a written "literacy" test which contains true/false and multiple choice questions.

The second unit in the course consists of two different blocks which use bookkeeping software and PFS-File/PFS Report. Accounting projects are completed with the bookkeeping software. For example, a sample company, XYZ is established. Books are set up and accounts are entered. New transactions are entered during the class periods. At the end of the block, balance sheets and monthly reports are constructed.

The PFS packages are used to teach the capabilities of data management software. Sample companies, such as an insurance company, are set up by the instructor. The students' assignment is to establish a filing system for 25 clients. Students must design a form, enter data, sort the file, collect new information and complete changes in the data.

There is also a test at the end of this unit. The first part of the test is paper-pencil and consists of true/false and multiple choice questions. The second part of the test is a practical application of the software used in the projects. Students complete a number of procedures with the program, manipulate data, and file the data. The test consists of three to four application problems.

The third block of time is spent learning the Easy Writer word processing package. A 31-page tutorial is included with the software. Students are expected to read the manual outside of class and then discuss any questions concerning procedures in class. Exercises are developed by the instructor to teach all operations of the software: how to enter text, manipulate paragraphs, incorporate content, enter letters, save files, change entries, etc. During this unit, 10 to 12 exercises are completed by the students. Again, at the end of the unit there is a two-part test; one section containing true/false and multiple choice questions and the second part, application problems which give the students an opportunity to illustrate their understanding of the software.

The last unit in the course is spent on spreadsheet analysis. Visicalc is the software used. There is no tutorial available with the software so the instructor presents the information in a lecture format. Class time is also spent on exercises designed by the instructor, including averaging grades, making changes in a grade book, adding and deleting columns, etc. At the end of the unit, there is another two-part test similar to the other tests given: one section is true/false and the other is an applications section where students must enter and manipulate many types of data. Currently, there are no textbooks used in this course although the instructor is considering a book on Visicalc by Allen, Visicalc for the IBM-PC (Publisher-Reston).

The faculty have considered teaching integration programs in this course such as Lotus 1-2-3 but they have decided not to do so at this time for a number of reasons. One, they want the focus to remain on literacy. Two, they want the content to be relevant to the job tasks that graduates will be required to perform when they are employed. The integration packages are currently not adaptable to the Apple's and TRS-80's that are found both in the schools and in area businesses. Thus, although the skills learned would be interesting, they are not directly related to what would be required on-the-job. Three, the IBM's in the lab are not capable of running a program such as Lotus 1-2-3. Instead of spending money to upgrade the computers in the lab to handle a program such as this, the faculty feel that money could be better spent on increasing their inventory of hardware.

More advanced applications of the microcomputer have been introduced into other classes now that instructors can assume students are computer literate. In classes such as Word Processing, Finance, Economics, General Business and Office Procedures, several weeks are reserved in the lab in order to complete a variety of projects.

Inservice Training

The Dean of the College and the Department Chairman have been supportive of all plans to integrate the microcomputer into the curriculum. With their support, the instructors in the college have been taught how to use the microcomputers. One of the instructors in the department, Buddy Krizan, has taken on a lot of the responsibility for implementation. He was a math major in college, took computer courses for two years in the military service, and earned his Ph.D. in Business and Vocational Education. He has designed and delivered the inservice training workshops. Initially, he organized the courses and learned about microcomputers on his own time. In addition, in 1982, during his summer professional leave, Dr. Krizan visited twenty businesses and six post secondary schools to learn more about computer usage.

The Dean is constantly encouraging faculty members to integrate the microcomputer into the curriculum in as creative a fashion as possible. To illustrate, during Spring of 1984 on Friday afternoons, Krizan was selected to conduct workshops to assist other faculty members with utilizing the microcomputer. They met for three hours each week (12 weeks = 36 hours of instruction). The inservice education was voluntary. During the inservice, time was spent learning five software programs--the same five that are taught in Office Administration #120. Approximately one-half of the faculty attended. Interest is growing among faculty members who are feeling the pressure to get involved. As a result, the inservice may be offered again in 1985.

Evaluation

The faculty has found that teacher/student relationships have improved since the microcomputer has been integrated into the business courses. Students now feel that instead of spending their time learning "ivory tower" theories, they are learning practical skills that are necessary for success on the job. The students respect the computers, and the role they will play in their future, and therefore are willing to put time and energy into learning about them. They appreciate both the body of knowledge and the instructor's mastery of the subject matter. There are more requests for help from individual students made directly to the teacher. That is very different from the passive learning that used to take place when students learned solely from a textbook or lecture. The request for help also serves to create a stronger relationship between the teacher and student. The Business faculty have also found that the image of the department has changed since they have incorporated the "up-to-date" computer skills into their curriculum.

Student/student relationships have also changed during this process. Because there is not enough machinery for each student to work alone on the computer, two students must work together at one machine. They must help each other and cooperate by taking notes while the other is using the computer. Communication has thus improved. Feedback on the course has been very positive. As evidence, the absenteeism rate is also down.

The biggest problem is the need for more machines. Currently, there are three sections of OAD #120 offered, with 50 students per section. That means that 150 students per semester are taking this course. Another shortcoming of the program is the lack of graphics. The hardware purchased is not capable of supporting a good graphics package.

The Future

The department is trying to teach keyboarding skills on the microcomputers but they are waiting for Southwestern Publishers to develop materials that can be used on the IBM-PC. When the materials are available, there will be a five-week one-credit course on keyboarding held in the microcomputer lab.

Summary

In summing up his experiences with the microcomputer component of the business program, Krizan suggests that when beginning, the hardware chosen should have a variety of capabilities. Their department began using IBM's with 64K. They have been upgraded to 128K and will soon need to be upgraded to 256K. They were not thinking "big" enough when they began. It is also important to get enough hardware to support the ideas of the faculty if the momentum is to be maintained.

He also added that schools using microcomputers extensively in their courses should consider networking when they are planning and organizing a lab. Controlling and keeping 800+ diskettes has become a full-time student-worker job and takes a great deal of organizing and managing to supervise. Networking, however, does create problems such as reducing the amount of flexibility and access to software not written for a network system.

USING THE MICROCOMPUTER IN A BASIC SKILLS PROGRAM

SCHOOL: Vocational Schools in the County of Middlesex
ADDRESS: 112 Rues Lane, P.O. Box 220, East Brunswick, New Jersey 08816
TELEPHONE NUMBER: (201) 257-3300
INSTRUCTIONAL PROGRAM: Basic Skills Improvement Program: Remediation Programs in Math and Reading
CONTACT PERSON: Elinor French, Coordinator of Basic Skills

The Vocational School System in the County of Middlesex is a full-time four year vocational high school system. The system includes five high schools which serve Middlesex County in New Jersey. The schools draw from 25 school districts and 43 private and parochial schools in Middlesex County. All students are in the Industrial Education curriculum. Both academic subjects and industrial-related subjects are taught. Because the students come from a variety of educational institutions, the vocational high school system has no input into the K-8 curriculum. Many of the students who attend the vocational high schools arrive for the 9th grade with deficiencies in both reading and math.

Several years ago, the Basic Skills instructors were searching for a new way to teach the many students who had been identified as deficient in reading and math skills. In order to overcome the barriers from past frustrations and failure patterns in the more traditional K-8 curriculum, it was recognized that an entirely new approach was needed. The coordinator decided that using a microcomputer for drill and practice in the Basic Skills was worth exploring and eventually implementing.

Equipment

A Reading Lab and a Math Lab were established in each of the five high schools. The district bought a total of 76 Commodore PET computers, 17 printers, and 13 disk drives. There are usually sixteen students and two teachers assigned to each remedial lab at one time. An attempt is made to keep the student/teacher ratio at 8:1. Depending on the amount of space at the facility, there are 6-12 machines in each lab. Students are assigned to the remedial lab for 45 minute periods, five days per week. When they are completing work, there is one student per machine. When they are not doing their practice work on the microcomputer, they are in the formal classroom area with the teacher. Approximately 800 students go through the remedial lab each school year.

The Curriculum

The microcomputer facility is used primarily to diagnose, test and manage instruction. Drill and practice software is also available at the computer stations but teaching of concepts is still done by the classroom teacher.

The principle underlying the curriculum design is "the development of each student's potential by identifying and meeting the needs of the individual student." Therefore, an Individualized, Diagnostic/Prescription Program is utilized. It is designed so the students and teacher must work together to achieve mastery. The components of the program are:

Step 1 - Assessment by diagnostic testing

Step 2 - Analysis by the computer to determine areas of weakness

Step 3 - Selection of objectives to be mastered in order to correct skill deficiencies

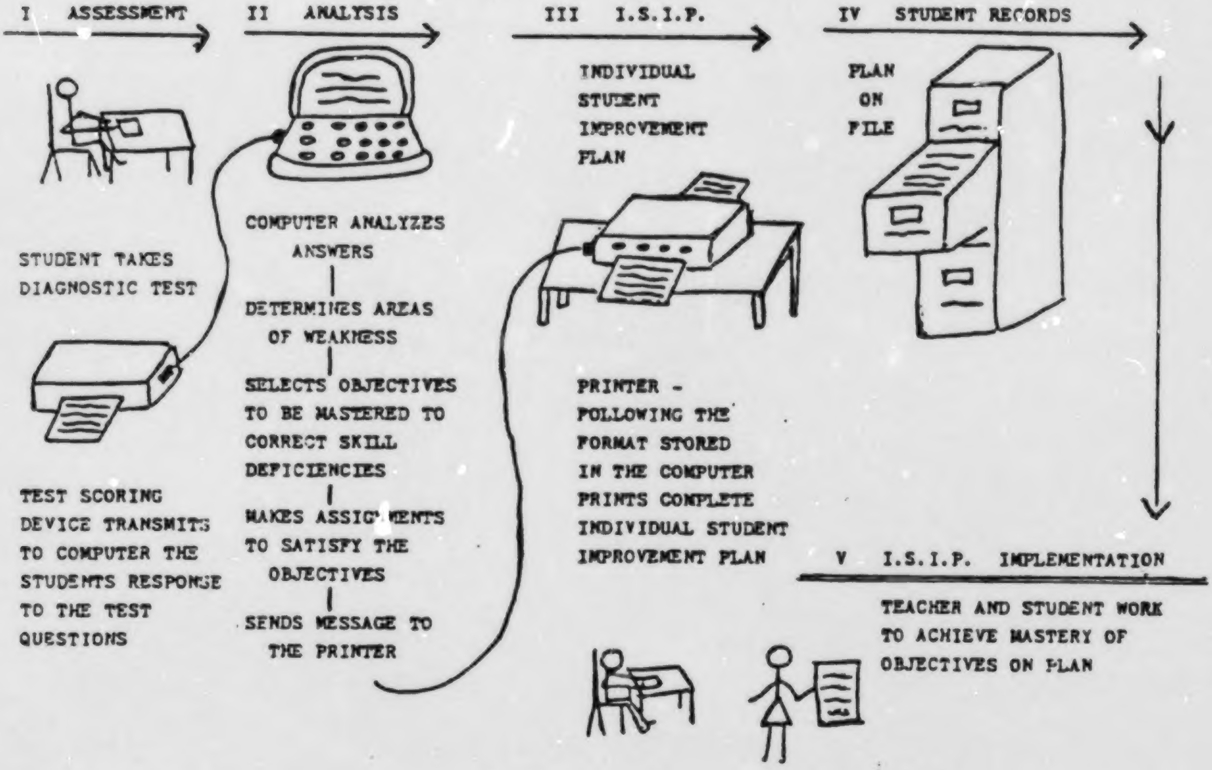
Step 4 - Creation of an Individualized Student Improvement Plan for each student

Step 5 - Implementation of the plan by student and teacher working together to achieve mastery of the plan's objectives.

The following drawing depicts what actually happens when a student is sent to the Reading Lab. (A similar process takes place in the Math Lab.)

Figure 1

READING LAB


I ASSESSMENT
II ANALYSIS
III I.S.I.P.
IV STUDENT RECORDS
STUDENT TAKES DIAGNOSTIC TEST
TEST SCORING DEVICE TRANSMITS TO COMPUTER THE STUDENTS RESPONSE TO THE TEST QUESTIONS
COMPUTER ANALYZES ANSWERS
DETERMINES AREAS OF WEAKNESS
SELECTS OBJECTIVES TO BE MASTERED TO CORRECT SKILL DEFICIENCIES
MAKES ASSIGNMENTS TO SATISFY THE OBJECTIVES
SENDS MESSAGE TO THE PRINTER
INDIVIDUAL STUDENT IMPROVEMENT PLAN
PRINTER - FOLLOWING THE FORMAT STORED IN THE COMPUTER PRINTS COMPLETE INDIVIDUAL STUDENT IMPROVEMENT PLAN
PLAN ON FILE
V I.S.I.P. IMPLEMENTATION
TEACHER AND STUDENT WORK TO ACHIEVE MASTERY OF OBJECTIVES ON PLAN

BEST COPY AVAILABLE

As illustrated, the laboratory provides the teacher with the necessary tools to manage a successful learning environment. Instruction is based on mastery learning and is implemented systematically with a diagnostic test that enables both the student and teacher to determine which skills have already been mastered, the objective at which instruction should begin, and prescription/ assignments determined (See Figure 2).

Figure 2

EXAMPLE OF DIAGNOSTIC/CHAPTER TEST RESULTS

Test Number 1108	Date 05/04/84 Student: Student 1801B1
Objective Mastery % = 100	
Number of objectives tested 24	Number of items tested 30
Number of objectives mastered 3	Number of items correct 4
Percent mastered 13	Test Score % = 13

Objectives Not Mastered
Prescription/Assignment

19206	Rectangle Stein first P433 434 (1 A-G)
19110	Properties of odd & even Stein first P26 (1 2 3)
19009	Addition - Decimals Arith P281 16-1 (1-10)
19302	Graphs Foun math P161 (9) Foun math P158 Test A Foun math P159 4
19006	Subtraction - Fractions Foun P61 (Test B)

Figure 2 cont'd.

19211	Money Trouble shooting P41 (1-4)
19008	Division - Fractions Arith P213 (5-15)
19312	Quantities and conversions Learn to compute P131 (13-15) P132 (17 18)
19011	Multiplication - Decimals Arith P299 (1-5)
19005	Addition - Fractions Arith P154 (5-15)
19308	Ratio/proportion Arith P395 (1-3)

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As noted from Figure 2, the test results are broken into those objectives mastered and those not mastered. Figure 2 includes a printout of the objectives which still need to be mastered. Next to the objective(s) not mastered is a prescription of the work that needs to be completed in order to master the skill. The teacher chooses the appropriate prescription and assigns that work to the student. The assignments are completed by the student in the classroom or by using drill and practice software at the microcomputer. Then, a mastery test is taken at the microcomputer. The results of that test are used to make the next prescriptive assignments. If students receive an 85% or better, which is considered mastery, they can then move to the next group of skills. This process eliminates testing and instruction that is "too easy," "boring," or "too difficult."

Teaching new concepts is still done by the classroom teacher in the classroom area. Students are helped by the teacher when they have difficulty with a particular concept and then work at the computer with drill and practice software until they have mastered that skill.

The Reading Lab

The Reading Lab was established in each of the schools to serve students who were identified as needing remedial help in reading. Two criteria were used in selecting students:

1. those students who scored below 75% on the New Jersey Minimum Basic Skills Test given to 9th and 11th graders, and/or
2. those students who scored below the 30th national percentile on the California Achievement Test given to all students.

The following broad objectives were used to develop the curriculum offered in the lab:

1. To develop basic fundamental reading skills
2. To make reading concepts meaningful to the students
3. To develop the ability to understand what is read and to develop an enjoyment of reading both in school and out of school
4. To establish an understanding of the vocational application of reading skills and concepts
5. To develop the following abilities—comprehension, accuracy, and fluency—so that the student is able to read with fluency and understanding

As indicated earlier, a test is given when a student enters the lab. Skills which need to be mastered are identified and a prescription is prepared by the computer based on those test results. Assignments are listed with the prescription. The appropriate assignments are chosen by the teacher. Once they are completed, a mastery test is given. If the student passes, s/he can move on to the next group of skills to be mastered (See Figures 3 and 4).

Figure 3

READING PROGRAM MATERIALS CODING

- B - Barnell Loft Specific Skills Series
  - B1 E - Getting The Main Idea - Books D & E
  - B1 F - " " Books F & G
  - B1 H - " " Books H
  - B1 I - " " Books I & J
  - B2 E - Locating The Answer Books D & E
  - B2 F - " " Books F & G
  - B2 H - " " Books H
  - B2 I - " " Books I & J
  - B3 E - Following Directions Books D & E
  - B3 F - " " Books F & G
  - B3 H - " " Books H
  - B3 I - " " Books I & J
  - B4 E - Drawing Conclusions Books D & E
  - B4 F - " " Books F & G
  - B4 H - " " Books H
  - B4 I - " " Books I & J
  - B5 E - Getting The Facts Books D & E
  - B5 F - " " Books F & G
  - B5 H - " " Books H
  - B5 I - " " Books I & J

- BP - Benific Press - Words We Use

- C - Cambridge Book Co.
  - C1 - Reading Improvement
  - C2 - Reading Performance
  - C3 - Reading Competence
  - C4 - Reading Achievement

- CR - Croft Inc. - Skillpacks
  - CRA1 - Reading Comprehension Books A1
  - CRA2 - " " Books A2
  - CRA3 - " " Books CRC3
  - CRB1 - " " Books "
  - CRB3 - " " Books "

- CSO - Course of Study Outline - English 1982

- CUA - Curriculum Associates
  - CUA1 - Useful Words
  - CUA2 - 30 Lessons in Outlining
  - CUA3 - Vocabulary Power
  - CUA4 - Lessons in Paragraphing
  - CUA5 - Vocabulary Development

- D - Dreir - Basic Word Vocabulary Test

- I - Ideal Cassette Tapes

Figure 3 cont'd.

- ICT - Instructional Communications Technology Guided Reading Study Guide

- J - Jamestown Publishers - Comprehension Skills Series
  - J1 - Understanding The Main Idea
  - J2 - Making a Judgement
  - J3 - Understanding Characters
  - J4 - Drawing Conclusions
  - J5 - Making an Inference
  - J6 - Recognizing Tone
  - J7 - Appreciations of Literary Forms
  - J8 - Retaining Concepts/Organizing Facts
  - J9 - Isolating Details
  - J10 - Understanding Vocabulary

- JGC - Jamestown Publishers - Graphical Comprehension

- K - Kottmeyer - Conquest in Reading

- MC - McDougal Littell - Basic Skills in English
  - MC2 - Practice Book 2
  - MC3 - " " 3
  - MC4 - " " 4

- MCP - Modern Curriculum Press - Skillbooster
  - MCP1 - Using Maps, Charts, Graphs
  - MCP2 - Building Life Skills
  - MCP3 - Building Word Power
  - MCP4 - Skillstation - Building Word Power

- M - Midwest Publications - Basic Thinking Skills
  - MA - Antonyms & Synonyms
  - MB - Critical Thinking Book 1
  - MC - " " Book 2

- N - Nat'l Textbook Co. - Reading by Doing

- NJ - New Jersey Survival Skills

- NRP - New Readers Press - Practice in Survival Reading
  - NRP1 - Machine Age Riddles
  - NRP2 - Signs Around Town
  - NRP3 - Label Talk
  - NRP4 - Read The Instructions First
  - NRP5 - Your Daily Paper
  - NRP6 - It's On The Map
  - NRP7 - Let's Look It Up
  - NRP8 - Caution: Fine Print Ahead

Figure 3 cont'd.

P - Prentice Hall - Be A Better Reader
  - PA - Level A
  - PB - Level B
  - PC - Level C
  - PD - Book 1

R - Random House - Wordpacer
  - RA - Card A
  - RB - Card B
  - RC - Card C
  - RD - Card D
  - RE - Card E
  - RF - Card F
  - RG - Card G
  - RH - Card H
  - RI - Card I

Random House - Spotlight on Reading Charts, Graphs, Maps
  - RHA - Red
  - RHB - Tan
  - RHC - Green
  - RHD - Blue

RN - Reading a Newspaper

S - Scott Foresman, Reading Tactics
  - SA - Book A
  - SB - Book B
  - SC - Book C
  - SD - Book D

SC - Scholastic - The Jobs Book

SP - Spice Series
  - SP1 - Volume 1
  - SP2 - Volume 2

SSO - Systems 80

T - Taskmaster

Figure 4

PRESCRIPTION/ASSIGNMENTS FOR READING PROGRAM

Grades 9 - 10
Prescription/assignments
Word recognition - 28000

28001	Sight Vocabulary BP-BK8, CSO 52-58, CUAI, CUA2, D I 1-12, K, MCP4, SSO-BKB, KTB.
28002	Syllabication MC2 178-179, 435-436, SA 12-14, 50-54, SB 8, 42-43, SD 7, 40-46, 89, SP 1-11, SP2-7, T 1-23.
28003	Possessive Contractions MC2 247-249, 433-435, MC3 314, 483-485, MCP3B- 36-37, 38-39, 44, MC2W 170. RI
28004	Context Clues CRA1, ICT C, D, E, H, K, MC2 4-9, MC3 6-11, MCP3D - 5-9, 17, 19, 25-27, 30-35, 37-38, 40-41, 44-45, RA, SA 1-7, 9-26, SB 2-7, 11-23, SD 1-5, SD 9-19.
28005	Synonyms CRA2, M 1-30, MC2-10, 11, 178. MC3 12-13, 185-186, MCP3 28-29. MCP3B - 28-29, MCP3D- 14-16, 21-22, 33. RC. SD 68-71. T GR 4-6.
28006	Antonyms M 1-30, MC2 10, 11, 178. MC3 12-13, 185-186. MCP3B - 30-31, MCP3D -24, 39, RD, SP1-19, SP2 19-21, T - GR 4-6.
28007	Homonyms MC2 451-455, MC2 W 181. MC3 - 501-507, MC3 W 182-184, RE, SA - 67-69, SD 64-67. SP1-23, SP2-20.

Grades 9 - 10
Prescription/assignments
Comprehension Skills - 28100

28101	Main Idea As Stated B1-E, B1-F, C1- 1-3, C2-168-170, PA - 126-7, PB- 80, 160, RN- 6-11, SB 107-109.

Figure 4 cont'd.

28102 Identify Factual Information
B2-E, B2-F, C1-4, C2-170, CRA1, CUA2- 19-26, CUA4- 19-26, 35-45, NRP7 - 36-57, PA-125, PB-80, RN 14-19, 21-25, SA - 166-170, SB 160-163.

28103 Signal Word In Context
C1 - 6-8, C2 -16-18, C2-24-25, CRA-3, PB-53, SA 18-19, SB- 13-20,

28104 Following Directions
B3-E, B3-F, C1- 75-79, C2-48-49

28105 Identify Main Idea
B1-E, B1-F, C1-1-3, C2-168-69, CUA2 1-5, 6-11, 12-18, CUA4, 12-18, 27-34, J1, PA-21, 22, 48, 126, PB- 22, 54, 106, SA 105-108, SB 105-106, PD-50, 51

28106 Make Inferences
B4-E, B4-F, C1-12-20, 71-73, C1-143-147, C2-7-12, 27-31, 82-83, 96-97, CRB-3, CUA4 59-68, J4, MC3-10-11, RN-12-13, SA 79-102, SB 77-100

28107 Fignative Language (Idioms)
PA 150, 170

28108 Fact or Opinion
B5-E, B5-F, MC3W-35, PA 125, PB 132, 170, RN 50-51, PD-10, 11, 30

28109 Identify Authors Purpose
C2-77-85,

28110 Determine Validity

28111 Relate Idea Not Discussed
B4-E, B4-F, CR B-1, J-4

28112 Relevant/Irrelevant Information
C2-31-33, CRC-3, CUA4 46-58, J8, J9, NRP 2,

Grades 9-10
Prescription/assignments
Study Skills - 28200

28201 Reference Skills
NRP 7-4-24,

Figure 4 cont'd.

28202	Guide Words
28203	Dictionary Meaning PA 148, PB 169,
28204	Table of Contents PA-128, PB 130, RHB-3
28205	Index C2 117-18, 121-2, NRP7-16-18, RHB-4
28206	Use of Appropriate Reference Material C2 73-75, PA-171, PB-172,
28207	Appropriate Reference Source

Grades 9 - 10
Prescription/assignments
Life Skills - 18300

18301	Road Maps C2-113-116, 123-128, NRP6, PA-46, PB-142, RHA-18, RHB-21-22
18302	Line Graphs NRP 7-26, PB-166, RHA-16-17, RHB-14,15
18303	Bar Graphs NRP 7-28, RHA-12, 13, RHB-10,11
18304	Circle Graphs NRP 7-32, RHA-14, 15, RHB-12,13
18305	Picture Graphs NRP7-30, RHA-10, 11, RHB-7,8,9
18306	Cartoons NRP5-20, 50, RN 26-30, 52-53
18307	Flow Charts RHA-6-9, RHB -5,6
18308	Diagrams NRP7-40, RHA-4, 5, RHB-2,
18309	Label NRP3, RHB-19, 20
18310	Directions C2 99-101, NRP4, RHA 19-21, RHB-16-18, RN 32-37, 41-44.

The Math Lab

A Math Lab has been established in each of the five schools to develop a special mathematics program for those students who have been identified as deficient in math skills. Two criteria are used in the selection of students:

1. those students scoring below 65% on the New Jersey Minimum Basic Skills Test given to 9th graders, and/or
2. those students scoring below the 30th national percentile on the California Achievement Test given to all students.

The following broad objectives were used to develop the special mathematics curriculum offered in the Math Lab:

1. To develop basic, fundamental math skills
2. To make mathematical concepts meaningful to the student
3. To develop the ability to do and understand word problems. This includes developing a math vocabulary and mathematic reading skills.
4. To establish an understanding of the vocational application of mathematics skills and concepts
5. To develop the following abilities--speed, accuracy, and neatness

Assignments are given to meet those objectives (See Figures 5 and 6 on following page.)

Figure 5

MATH LAB - TEXTBOOK CODING

- S - Individualized Computational Skills - Houghton Mifflin
  - S1 - Strand 1
  - S2 - Strand 2
  - S3 - Strand 3 etc.

- M - Mastering Computation Skills - Scott Foresman
  - M1 - Book 1
  - M2 - Book 2
  - M3 - Book 3 etc.

- L - Learning to Compute - Harcourt Brace
  - L1 - Book 1
  - L2 - Book 2
  - P - page

- IA - Introductory Algebra - Harcourt Brace

- IAW - Introductory Algebra Workbook

Figure 6

EXAMPLE OF ASSIGNMENTS FOR EACH MATH OBJECTIVE

QUESTION#	OBJECTIVE#	ANSWER	ASSIGNMENTS
1	19001	E	S1.4 M1 50 52 54 56 58 60 62 64 L1P1-11
2	19001	E	S1.4 M2 34 36 40 42 44 46 48 L2P1-9
3	19001	E	S1.4 M1 50 52 54 56 58 60 62 64 L1P1-11
4	19001	E	S1.4 M2 34 36 40 42 44 46 48 L2P1-9
5	19001	E	S1.8 M2 34 36 40 42 44 46 L2P1-9 MRL4-5
6	19002	E	S2.4 M1 68 70 72 74 76 78 80 82 L1P22-28
7	19002	E	S2.5 M2 52 54 56 58 60 62 64 66 L2P18-22
8	19002	E	S2.5 M1 70 72 74 76 78 80 82 84 L1P22-28
9	19002	E	S2.5 M2 52 54 56 58 60 62 64 66 L2P18-22
10	19002	E	S2.8 M1 70 72 74 76 L2P18-22 MRL 6-7
11	19003	E	S3.2 M1 88 90 92 94 96 98 100 L1P12 21
12	19003	E	S3.9 M1 90 92 94 96 98 100 102 L1P12-21
13	19003	E	S3.10 M2 72 74 76 78 80 82 84 L2P10-17
14	19003	E	S3.11 M2 72 74 76 78 80 82 84 L2P10-17
15	19003	E	S3.12 L1P12-21 L2P10-17 MRL 22-28
16	19004	E	S4.2 M1 106 108 110 112 114 116 L1P29-35
17	19004	E	S4.6 M2 88 90 92 94 96 98 L2P23-33
18	19004	E	S4.6 M1 106 108 110 112 114 116 L1P29-35
19	19004	E	S4.6 M2 88 90 92 94 96 98 L2P23-33
20	19004	E	S4.7 L1P29-35 L2P23-33 MRL 43-47

Classroom Management

The computer is also used for instructional management. By scoring tests, keeping records, making assignments, and printing individual and class status reports, it eliminates a large amount of paper work. The management program used is called Project BASIC, developed by the Evans-Newton Company in Arizona. The system keeps track of student scores. The teachers are able to put their own tests and prescriptive assignments into the system along with identifying skills which need to be measured. It is important to note that after the management system was purchased, it was necessary to hire a consultant to adapt the program to meet the specific needs of the Basic Skills programs. Tests are scored with a card reader. Printouts such as that in Figure 2 come from that system.

Elinor French recommends several software packages. She also found that Educational Activities, Inc. (P.O. Box 392, Freeport, NY 11520) produces quality software in the remedial areas for high school students, in both math and reading. Their software is generally drill and practice although there are some tutorial sections in the program. The tutorial sections are not used by the Middlesex County system. They prefer that the classroom teacher does the instructing and then uses the microcomputer to practice those skills.

Teacher Training

Teachers were trained in a three-day workshop supported by the Board of Education. During that time, the entire instructional and administrative microcomputer system was explained to all teachers that work in the remedial area. All labs use the same materials, thus maintaining a degree of standardization across the high schools. This enables the district supervisor to easily manage and supervise the work done in the labs.

Evaluation

When the computers were first purchased for the Basic Skills program, they were the only computers in the school so they were viewed as something special. In addition, most of the students are machine-oriented and feel more comfortable completing their practice sets on the machines. Parents are also very interested in the entire instructional process. Not only have students improved their skills (See Figure 7) but they have developed an independence about their work that is markedly different. Most remedial high school students have a mindset that they cannot learn what other teachers over the past five years have not been able to teach them. The computer has changed that. Students watch the computer score their tests and see an actual print-out of what they know and still need to master. It gives the students the feeling that they are participating in a personal experience, and one that is not dependent on a teacher's arbitrary decisions. The results come from the student's own performance on his/her own diagnostic test.

Students also seem to see the subject matter diferently. Practicing math on the computer does not feel the same as sitting down to complete a set of math problems with paper and pencil.

Figure 7

MIDDLESEX COUNTY VOCATIONAL AND TECHNICAL HIGH SCHOOLS
EFFECTIVENESS OF OUR BASIC SKILLS PROGRAM
Measured by Minimum Basic Skills Test

	Reading*		Math*	
	9th GRADE in 1980	9th GRADE in 1983	9th GRADE in 1980	9th GRADE in 1983
EB	82.4	83.3	82.9	84.2
NB	38.3	58.8	33.8	62.7
PA	68.1	86.5	82.4	91.4
P	54.9	71.2	57.5	74.2
W	52.0	94.0	61.3	95.5
Dist.	59.2	79.8	63.5	82.2
% CHANGE		+20.6		+18.7

*State Standard in Reading is 75%.
*State Standard in Math is 65%.

Problems

The biggest problem that the instructors have found is the lack of software and the problem of obsolete hardware. If the district were beginning computer-based education again, they would get different hardware. They must pay a programmer to write software for them, such as reading programs which contain vocational relevant topics, because there is no software available.

To alleviate many potential problems, it is suggested that a software system such as the Evans Newton Management System be bought which will allow the teacher to utilize other materials with that system which have already been purchased for the remedial area. It is a flexible system in that the user is able to integrate concepts and materials for remedial instruction into the computer-based system without buying an entire package.

MICROCOMPUTER INSTRUCTION IN AGRICULTURE & AGRIBUSINESS

By

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Assisted by:

Dr. Cortlyn Almquist, Dairy Herd Management Instructor
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Madison Area Technical College, Madison, WI

(From Microcomputers: Applications in Vocational Education, 1983)
By Rodenstein, J. and Lambert, R.
Vocational Studies Center

Microcomputer use in Agriculture and Agribusiness is no longer something on the horizon but rather a present day reality. The world of microcomputer electronics has enabled the small computer to be available for use as a tool in the making of management decisions in the farm industry. The effective use of the microcomputer will allow the manager of today's fast moving business to assign tedious, repetitive tasks to this "noncomplaining workhorse" to obtain management information essential to guiding the business.

One major problem being encountered by managers is to be able to obtain computer programs or "software" that will provide information that the manager wants and not what someone else thought they should have. Since most smaller agribusiness and farm operations do not have a computer "expert" at their beck and call, it is usually up to the manager or owner/operator to "know how to control the workhorse." This person will need to operate or train someone to operate the computer and software programs and also have the ability to "change the program" to meet new needs and desires for information.

Management of capital, in addition to production, is the key to the 1980's complex, fast-paced, technological era. As we are all aware, capital or "money" has replaced much of labor in the farm industry. In addition to the great increase of capital in the farm industry, economic conditions have now been changing from "profitable to unprofitable" in a relatively short period of time. This has strengthened the need for initial sound planning and alternative planning under various possible economic conditions to help the manager know where the business is headed under many pricing structures.

This planning (and alternative planning) was once available only by the long and tedious "pencil method" and more recently by using large mainframe computers at a University. Most of the procedures needed to provide this information can now be done by the manager at the place of business with a microcomputer and commercially available software programs. "Massaging and manipulating of data" by the computer will help provide the manager with the different answers that then need to be effectively evaluated by the manager.

After the planning stages of the business have been completed, the task of "monitoring" the "business" as the business year progresses becomes critical. This, of course, includes the need for income tax records of income and expense information and an enterprise analysis of income and expense information. These tasks can also be completed very effectively by the computer and an appropriate software program. Gone are the days of putting off recordkeeping until the end of the year and then "seeing how much profit was made when we have nothing else to do."

Computers are coming to the farm and agribusiness industry and it would appear that the vocational, technical and adult education systems need to have these subjects integrated into the curriculum. For the past two years the Madison Area Technical College has initiated courses which address these new subject areas.

Computer education and training can take two different avenues leading to approximately the same result:

1. One, the learning of a computer programming language to enable the manager to "program a computer" using a language understood by the computer.
2. The second is to teach the student:
    a. how to use the computer operating system,
    b. how to use 2 or 3 commercial software packages that will operate on the microcomputer, and
    c. some of the capabilities and limitations of the microcomputer and software programs.

At this time many agriculturalists have taken the first route since not much software has been written for agriculture and very little is known about what computers and software programs will do. Also, Ag people are known to be rugged "do it my way people" and so, of course, they want the computer programs to put out answers "my way."

However, we are now seeing many more software programs coming out for agricultural uses and there are sure to be more and better ones as needs become better defined by users. This brings us to the second option, presenting the process of basic computer and basic program instruction to the student who has little knowledge on the subject. Farmers who are "fully employed" do not have large amounts of time to gain knowledge in the area nor possess a desire to learn a seemingly "complex programming language" before it can be used.

This type of person would like to sit down at the machine, learn how to operate it and the software programs, and then revise the programs to make it do what they want it to do.

Program Objectives

At the Madison Area Technical College, Robert Mountford, one of the five Farm Training Program instructors, has taken the lead and been the innovator in this agricultural area. Over a two-year period of time he has developed the following observations of the student who needs computer training in the Farm Training program. These observations follow the second avenue of computer training as listed above because:

1. Very few students will have prior knowledge, or exposure to the use of microcomputers.
2. Basic terminology, word definition, slang terms and recognition of basic components is lacking on the part of most students.
3. Knowing what to expect of a microcomputer system or of different software programs, and how they work without ever using one, is next to impossible for the agriculture business and farm manager as they have nothing to compare to.

Therefore, the following objectives of the agriculturally-related computer education at Madison Area Technical College (MATC) are as follows:

1. To provide materials and sources so that the student may learn the definitions of the "jargon" and the vocabulary of the computer field so that s/he can become "literate" within the field.
2. To provide instructional time and hardware-use time so that the student may operate the computer "hardware" for a sufficient amount of time to gain minimum competency in its use.

3. To have sufficient instructor-guided instruction time and individual practice "hands on time" to learn how to use the computer "operating system."

4. To provide instructional time, hardware-use time, and a "Calc" electronic spreadsheet software program so that the student may use to learn the fundamentals of this type of software.

5. To enable the student to learn possible uses of "Calc" software; sufficient "agricultural" use templates should be provided for the "Calc" program so that the student can investigate possible uses in areas such as:

   a. Financial analysis procedures on the "Calc" programs.
   b. Projected twelve month cash flow construction templates.
   c. Ration of balancing and ration evaluation procedures.
   d. Comparative enterprise analysis procedures.
   e. "Data exchange files," that is, to take data from one program and move it to the "Calc" program for analysis or other uses.

6. To provide the instructional time, hardware time, and software to enable the student to gain minimum proficiency in the use of a "relational database system."

   a. Again, agricultural templates should be provided to enable the student to learn as easily and quickly as possible how this type of software can be utilized in the agricultural area.
   b. It should be compatible with the "Calc" program software to allow data transfer between them.

7. A commercial agricultural business record system and a word processing software program could also be offered to students to round out their basic education on the use of computers and computer software in agriculture if time and funds are available.

After completing three or four courses such as these, students should have a basic understanding of what the computer and some of the commercial software can do in basic agricultural farm applications. Students should then be better prepared to define their needs, if any, for a microcomputer in their business.

It should be noted that these objectives relate to "how to." As the students learn to be literate with a computer and a "software program" they should have opportunities within the course/s to deal with real or simulated problems involving the use of software to provide information for management decisions. When problems involve actual facts and figures from students' worksheets, the concern for keeping information confidential becomes an issue. This may be solved by storing the information on a storage medium or disk that is portable and the sole property of the student.

Faculty Training

In meeting these objectives, the agriculture instructors at MATC have started to get the background training and experience to offer this kind of instruction. Three of the five instructors own their own computers and have contributed much to develop curriculum and course content from scratch. This is a slow and time consuming addition to their present workload. Consequently, most of the material is related to the group of persons they are training—farmers, dairy herd managers, etc. At this point, most of these courses have been directed to production agriculture. Little has been done, to date, for agribusiness even though instruction is also greatly needed there. Agribusiness firms, as well as farmers, need computer training for use in cash flow, financial management and inventory control, billings, etc.

Some of the typical examples of computer education incorporated into the curriculum of VTAE Agriculture-Agribusiness instruction are as follows:

1. Use of the "Calc" spreadsheet programs with Ag templates for cash flow construction, square method of ration balancing, ration evaluation programs, loan interest tables, production analysis with crop and livestock budgets, and long range financial planning.

2. Use of ration balancing programs designed and programmed by the instructor.

3. Use of fertilizer requirements and comparative cost analysis programs.

4. Use of livestock profitability programs with returns to labor, capital and management.

Other programs to be added to the curriculum as time allows will be the use of:

1. a "file management" data base program for data storage and retrieval,

2. "relational" data base programs for information that can be retrieved for analysis and interpretation, such as:

   a. financial information,
   b. dairy herd information,
   c. other livestock information, and
   d. crop record information, inputs, yields, etc., and

3. a commercial record program that will interchange information with "Calc" spreadsheet program.

Some typical examples of agricultural computer education incorporated into the curriculum of other VTAE Agriculture-Agribusiness instruction are as follows:

1. The Fox Valley VTAE District (Appleton, WI) will provide all farm training instructors with the use of a microcomputer and appropriate software effective July 1, 1983. One week of intensive training will be provided prior to that time with additional continuing education to be provided as needed. They also have a course in Agriculture Microcomputers as a requirement in all agribusiness programs.

2. At Milwaukee Area Technical College, teacher developed plant identification drills for horticulture and horticultural math are used. Also, courses in "Agrimarketing" and "Computer Applications in Agribusiness" have been taught by James Schug using microcomputer applications.

3. Milton Olson at the North Central VTAE District (Wausau, WI) has taught courses on the "Computer in Agriculture" and utilized such training in their Farm Operations Program.

4. At Western Wisconsin Technical Institute (LaCrosse, WI), Hilbert Hoof has taught microcomputer based courses in their Farm Operations and Farm Training Programs.

Problems Encountered

Advantages of computer education in agriculture and agribusiness are obvious. The possibilities for its use are endless. It is a new skill persons in these occupations will need and it is the mission of the vocational-technical education system to provide this training. There are disadvantages also. Those which have been encountered to date are:

1. The cost of equipment to set up a computer instructional area is expensive for most school budgets. However, keeping in mind the Agrarian reform and the Industrial reform which substituted machines and capital for labor, the computer will, at some date in time, be viewed as another "essential capital" investment by many persons in the industry and vocational education. Until that time "capital investment" limits the number of teaching stations and the number of hours that a student may use the station.

2. Computer stations should not be used as a "service tool" by the student or by the educational course offerings. Data bases and record programs should be used for educational purposes only, not allowing the student to "use the computers to keep personal or business records."

3. Microcomputers are relatively new and everyone is curious but because of the lack of enough teaching stations and their cost, priorities must be given to students who can utilize this training in their present or future jobs.

4. Software packages that are useful can be defined as:

   a. "Calc" spreadsheet programs
   b. File manager data base programs
   c. Relational data base programs

5. The problem in selecting and becoming proficient in the use of a software package is that "you have to have used one to be able to know what to compare something to anything."

    a. All appear to have some "quirks that someone wishes to work differently."
    b. It takes 40 or more hours to become familiar enough with a software package to use it effectively.
    c. It may take 10 to 40 hours to set up and revise each template on a "Calc" spreadsheet.
    d. Data base file procedures, screen procedures, selection and report procedures may take 10 to 100 hours to set up and revise.

6. Some software is only adaptable to certain kinds of computers.

7. Many instructors have not received adequate training to teach such courses. Inservice training may help the instructor get started, however, it appears that the best way is to "jump in" and start learning.

Summary

The overriding objective in microcomputer education for farmers and agribusiness is to lay the groundwork for a self-service skill training that meets their financial management needs. The Ag industry is going to have personal computers but the issue is whether or not they will be able to use them effectively in their management. The key is to plan training that is flexible, versatile and that can be adapted to changing needs and changing technology in farming and agribusiness. Computers are the tools needed to become efficient and effective in the business. In the opinion of the authors, we've scarcely scratched the surface.

THE MICROCOMPUTER IN AGRICULTURAL EDUCATION

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PROGRAM: Agriculture
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The Academic Computing Center at District One Technical Institute was opened in 1983 as a support unit for integrating computers into the curriculum. The goals of the Center are first and foremost to prepare students to understand the capabilities and applications of current computer technology. This means that instructors who need computer equipment to teach computer applications within their curriculum will be supported by the Center to 1) get that equipment, and 2) receive the training necessary for using it effectively. For example, the design and drafting program has received Computer-Aided Design equipment and training because that is the direction industry is taking. It also means that agriculture instructors would have access to computer equipment because farmers need effective computer control of their operations in order to compete in today's markets. It means that food service, fluid power, secretarial science, machine tool, accounting, electro-mechanical and marketing instructors will be purchasing computer equipment to train their students in the computer applications within their respective fields. The philosophy is, if an employer is converting to computer-generated products and there is a lack of computer knowledge in their current workforce, there would be a high demand for graduates with computer training.

Implementing this philosophy requires not only upgrading equipment, but more importantly, developing the skills and knowledge in the faculty, and revising curricula in order to provide needed training for students.

The policies of the Center were developed around the belief that faculty must first become knowledgeable about what is needed; they must learn then how to integrate those skills into the curriculum, and finally understand the problems inherent in teaching it. As noted, the Academic Computing Center was established by the district to assist instructors in this process. They offer courses on computers for instructors in order to begin this learning process. They also find suitable equipment and assist in the initial stages of implementation.

The following is a sampling from the list of software and documentation, by subject matter, currently available in the Academic Computing Center to support these efforts.

Agriculture

- Batch Mix
- Calf Weaning Weight
- Calibrate Field Sprayer
- Cash Flow
- Crop Budget
- Crop Income Possibility
- Dairy Balancer (Badger)
- Dairy Forage
- Dairy Quiz
- Depreciation Program
- Dfeed/printer
- Feed Value
- Feeding Livestock Budget
- Fertilizer Cost Program
- Grain Marketing
- Greenhouse Heat/Cooling
- Lawn Planning
- Machinery Econ Decision
- New TMR
- Nitrogen Program
- Pearson Square Instruc

- Pork File Maker
- Renumber
- Soil Loss Equation
- Statistical Analysis

Business

- A Marketing Simulation
- Accounts Payable
- Accounts Receivable
- Business Forecasting
- Capital Funding
- Critical Path Method
- Equipment Purchase
- Expected Value Cmputan
- General Ledger
- Inventory Analysis
- Job Pricing/Bidding
- Payroll
- Return on Investment
- Supercalc
- Visicalc Advanced Ver.
- Visifile V 1.5 Disk 2
- Visiplot
- Visitutor/Visicalc IIE

Graphics

- Business Graphics-Data
- Business Graphics-Plot
- Computer Aided Drafting
- Graphics Tablet
- Mousepaint
- Zoom Graphics

Industrial Arts

- Basic Electricity Test
- Board Feet
- Break-Even Point
- Budgeting Simulation
- Budgeting Tutorial
- Circuit Requirements F
- Consumer Math I
- Consumer Math II
- Engine
- Figuring Interest
- Micrometer
- Ohm's Law Program
- Sheet Metal Project Co
- Typing Tutor II

- Utilities Analysis
- Wood Characteristics

Miscellaneous

- Quiz Writer
- Super Co-Pilot 1
- Super Co-Pilot 2
- Superpilot Author Mast
- Superpilot Lesson
- Vocab Teacher
- Apple Writer IIE
- Apple Writer II Plus
- Bank Street Writer
- Magic Window
- Wordstar/Mailmerge

The Curriculum

This profile will examine on the uses of the microcomputer in the agriculture curriculum. The focus in the curriculum is on animal science, farm management, and crops and soils. There are three instructors in the Ag division and eight farm trainers who work off-campus in small groups or 1.1 with farmers. There are two types of programs on campus. One is a full-time day program on farm operations. That coursework is covered in four 9-week sessions. The other program is Agribusiness Sales/Service which is a two-year program.

The instructors also teach a three-year diploma program. It was originally called a Production Agriculture Program and was designed for veterans. That program is no longer in existence because too much time was spent in the classroom. Instead, the instructors are teaching classes to the farmers. One of those classes has been modified and focuses on the uses of computers in farming. A description of that course is included in the section, "Uses of the Microcomputer."

Inservice Training

The instructors learned how to use computers on their own time. They started using computers to balance dairy rations on a mainframe in 1979. The computer completed the mathematical calculations through a program that a work-study student wrote. The instructors had to provide their own computer to complete the work and obtained training in whatever way was convenient. At that time, there was not the administrative support that is present today for integrating computers into the agriculture program. Soon these programs were also used to teach animal nutrition and cattle management.

Today, the administration wants all students to be computer literate. Therefore, the Ag program has integrated the computer into the curriculum in order to develop needed job skills and competencies.

Uses In The Classroom

In the farm operations program, agricultural mathematics is being taught with computers. This not only helps students learn the skills but also gives them hands-on experience with the computer. Currently, they are using Apple II+'s and IIe's. They are still looking for a portable computer. The District will be using IBM's in the future so programs will eventually be adapted to work on the IBM, especially the business and financial aspects of farming.

The instructional cycle works as follows. The teacher initially instructs the students in a traditional classroom. The students then go to the open lab on their own to complete the assignments.

By using the microcomputer to complete projects, there is always an opportunity to apply concepts taught in the classroom to a hands-on activity in which students are actively involved in the learning process. They are putting their own data and information into the computer, often from their own farm or a neighbor's farm, and are using the results, e.g., a ration project in nutrition class, for a home herd or the neighbor's herd.

These programs, it should be noted, need to be developed for student usage. Generally, this means that the student does need some information beforehand and instruction along the way to use the program. This means that the materials are useful for on-the-farm use but need to have the instructional component added to be useful in the classroom.

The software used in financial management is Visicalc. Farm management games which simulate records are also available to students. In these simulations, the student has an opportunity to keep balance sheets for a farm and make decisions while interacting with the data as though the farm was actually being managed. For example, the student begins with the option of buying three different farms and three different herds at three different production levels. All decisions that a farmer will have to make must be made by the student to make during the simulation. According to students and instructors, the experience is practical, innovative and very educational.

Computers are also being used to teach ration-balancing. First, the formula and concepts involved are completed by hand. After the student understands the process, the computer does the calculations necessary to complete the formula. The student merely needs to know what figures to plug into the formula.

Much of this work is completed in the computer room. In that room (designed only for hands-on instructional experiences and not teaching by an instructor) there are up to 22 computers—mostly Apple's. They are used by the entire school. There is also a word processing lab, with TRS-80's, used primarily by the secretarial science students. The instructors also use the program Quizwriter to develop a set of questions similar to an exam which students can study independently while preparing for exams. There is a management component to that program so the instructor is able to maintain a record of who uses practice tests and how much effort they are putting into learning the material.

As mentioned in the introduction, for-credit classes are also designed to "take to" the working farmer. Several of those classes focus on the use of the computer in farming. For example, there is an eleven week course—Agriculture Computers for Farmers; five classes are on BASIC programming with Applesoft to teach literacy rather than programming skills and five classes teach Visicalc to illustrate the uses of the computer in managing the finances of the farm. During one class, a vendor is invited to demonstrate farm-oriented products to those enrolled in the course. The majority of the farmers who register for these courses anticipate using the computer in the future. They are frequently at the point of deciding whether to buy a computer, what to buy, how to identify and evaluate software, and to become generally literate in the capabilities and shortcomings of the microcomputer.

In the future, the Ag division expects to offer advanced BASIC, advanced Visicalc, or a course that meets once a month which has the orientation of a "user's group."

The students in the Ag program also have the opportunity to become familiar with WISPlan, a program originating from the University of Wisconsin-Extension on the DEC PDP-11. It can be accessed with a modem and a dumb terminal or a microcomputer such as the Apple with modem capabilities. WISPlan contains a program called "Total Mixed Ration," used in the ration balancing instructional unit. Using WISPlan helps students become familiar with resources in the state and the ways to access those resources once employed in an agriculturally-related business.

The Future

In the future, the division also hopes to make better use of the modem and dumb terminal. For example, the modem could be used to communicate with all the farm training instructors. It is also possible to develop a file on an Apple disk that will have all the input information for WISPlan. It will reduce the cost of using a database and program such as WISPlan. In addition, students will be able to keep their work on a diskette at the terminal.

Hopefully, a word processing program and a graphics component will be incorporated into the software that is used in agriculture. To date, most uses involve the manipulation and development of data and information. In the future, word processing and graphics will need to be integrated into the computer component of the agriculture program before the instructors feel they are making use of the full capacitites of the microcomputer.

Vocational "CAD" Education at the Indian Valley Vocational Center

Sandwich, Illinois
By Mark Schwendau

Background

Indian Valley Vocational Center (IVVC), Sandwich, Illinois began teaching vocational drafting to high school juniors and seniors nine years ago. IWC drafting students never had to fiddle with antique drafting equipment such as T-squares, angles, and protractors--instead, they were equipped with the most up-to-date equipment of the day. That equipment included modern track type drafting machines, pedestal drafting tables, and a variety of templates. While that equipment was modern yesterday, it is rapidly becoming outdated today. Thanks to a progressive advisory council and school board, IWC has moved into the 21st century with the implementation of the first vocational computer-aided design (CAD) program in the state of Illinois.

For those who are new to computer-aided design, CAD involves the creation of graphic designs on a video display screen by computers and other electromechanical devices. The designs may be printed or plotted to hard copy or stored to disk to form a data base. CAD is to the drafter as word processing is to people that work with words. Because a picture is worth a thousand words, and the computers that create these graphic pictures must do much more than the average word processor, CAD systems usually cost thousands of dollars more than the average word processor.

The IVVC Drafting and Design advisory council researched the CAD market for three years before deciding to purchase the Apple-based CADAPPLE software of T & W Systems. The council liked the information that T & W Systems provided. Even better was the total turnkey system price of less than $12,000. In computer-aided design a turnkey system is a system that is considered to be a complete, ready-to-use system as it is sold. The companies that market these systems usually provide operator training as part of the system price.

Justification

The primary objective of IVVC is to provide entry level job training. Considering that almost all different types of industry will have adopted CAD over drafting tables by the year 2000, IVVC felt it would be foolish not to be offer CAD instruction. A person on a CAD system is considered four to eight times more efficient than a person at a drafting table with a drafting machine. Specific benefits are listed below.

1. CAD is unquestionably a faster method of creating drawings.
2. Once data is loaded into the data base, modifications are made more quickly; easily increasing productivity by as much as 100 times.
3. CAD systems give designers more time to experiment with new designs that might otherwise have gone untested.
4. CAD, with 3-D enhancement, eliminates the need for costly and time consuming model building.
5. CAD eliminates the drudgery of the drawing process.
6. CAD offers control and flexibility in drawing creations that never existed before through combinations of layering and nesting drawing views or individual elements.

These are just a sample of the more popular reasons a company chooses a CAD system over the traditional manual approach to drafting and design. Industry has little reason to maintain the old practices.

Program Overview

IVVC students use their CADAPPLE turnkey system to complete drafting problems assigned by their instructor from their workbook CAD-Tutor, a self-paced workbook that contains both study questions and drawing problems. The software is contained on four diskettes. The software is written in the UCSD Pascal computer language, however students need not know sophisticated computer programming because all commands and command prompts appear in simple English. Drafting function commands are selected from a menu by the student with single keystrokes. Students in the IVVC program are stationed at the system for one week as an observer doing written assignments and assisting the operator. The second week the student serves as the actual operator. IVVC students have found this "buddy system" works best for them. They are usually pretty well adjusted to the system by the time they take the operator's seat. The students rotate taking turns through the entire school year. Naturally, the larger the class, the less computer time each student gets.

System Overview

Eight primitives (geometric objects) are provided by the CADAPPLE system. These primitives can be combined into more complex groups that give the designer drawing speed. The primitives are lines, arcs, circles, rectangles, ellipses, regular polygons, Bezier curves, and text. For example, by using the system a road stop sign can be created with two primitive commands (polygon and text) and saved as a group named "Stop Sign." Groups can be further modified. They can be moved, copied, and rotated as the designer desires. Besides primitives, the system also supports automatic dimensioning where the full scale numeric value of a distance is calculated by the computer. The computer prompts for the desired distance to be dimensioned, the distance the dimension is to be placed from the view, and the location of the dimension's text.

The system supports five different input modes including the Houston Instruments' DT-11 Digitizer, Apple Joystick, and keyboard entry of coordinates using absolute, relative, and polar modes. Grids are maintained on the viewing screen according to specifications established by the operator. The grids are divisible by the operator as well. A coordinate dial can be used to continuously report the real world coordinate position of the graphic input device. The dial provides a readout to ten thousandths of an inch. The system maintains coordinate data to an accuracy of over six digits. Objects as large as 100.0625 inches have been accurately created on CADAPPLE. Floppy disk CADAPPLE systems, such as the IVVC system, have been used to store 1,600 primitives in one drawing.

System Configuration

The IVVC system uses two floppy disk drives, using both drives at all times. The CADAPPLE "Boot" disk contains most of the drafting commands for the computer. The "Work" disk is used as a temporary workfile for day-to-day work. The "Help" disk is a summary of the

CADAPPLE reference manual and is swapped with the Boot disk when the operator needs quick help with a particular drafting function command. The "System" disk is used to accomplish standard Pascal file management functions.

CADAPPLE software comes with two printed circuit boards or cards (in addition to the four diskettes) that are plugged into the Apple's ports. The CADAPPLE card is a custom-made card by T & W Systems that allows the Apple to do drafting functions. The "Mill" card is a Pascal speed-up card that makes the Apple run faster.

The first stations IVVC purchased consisted of an Apple II+, two Apple Disk II drives (one with controller) for memory recording, one 12" Zenith CRT for graphic display, one 9" Sanyo CRT for menu display (with Videx card), a TG Joystick for an input device, and a Houston Instruments' DMP 7/8 flatbed plotter for hard copy output. A Hewlett Packard 7225B plotter was later donated to the program by the local Apple dealer.

The system supports both Houston Instruments and Hewlett Packard plotters that can draw up to 24" x 36", or what most drafters refer to as a "D" size drawing. The system gives the operator complete control over his/her destiny, even within the output menu. Operators can create and save user definable plot specs that control the relationship between what is seen on the CRT screen and what is plotted as hard copy. Printers may also be used to make a quick low quality hard copy.

Due to student requests for more computer time, a second station is planned for the 1984-85 school year. The second station will consist of the Apple IIe as the information processing unit, a

"Vitamill" card used for Pascal speed-up (in place of the Mill), and the Houston Instruments' DT-11 Digitizer (graphics tablet) for an input device. All other hardware will be the same as used with the first system. This second station will be similar to CADAPPLE turnkey systems adopted by industry. The systems found in commercial industries use an Axlon Ramdisk and "Accelerator" speed-up card. This gives them increased speed and drawing storage space. This version of the CADAPPLE results in an affordable alternative to many other CAD systems now on the market.

IVVC students trained on CADAPPLE are adaptable to many different applications of T & W Systems including the IBM-PC VersaCad system, the Mars-CAD system of Staedtler Mars, and the Hewlett Packard 2-D Based Drafting system. In addition, T & W Systems are similar in command structure and operation to both the IBM CADAM and Unigraph CAD systems.

Critics of the CADAPPLE turnkey CAD system have wrongfully dubbed it a "toy" presumably because it runs off of an Apple computer. A recent issue of Machine Design magazine reported, "These new (inexpensive) systems are not toys but are designed mainly as entry-level systems for firms that cannot justify large sums (of money) for CAD. They also provide an inexpensive way of training CAD operators." The National Computer Graphics Association (NCGA) has filed a report that predicted a need for over 100,000 additional CAD operators by the year 1985. That same report indicated that the prohibitive costs of offering CAD training on some of the larger sysems was not cost effective, as only a fraction of the full potential of the system is realized in training. Most advanced CAD experiences occur on the job. Also, the number of students served by the larger systems in training centers is severely restricted. The NCGA report stated that it costs about $10,000 and 120 hours of training during a period of six weeks to acquire 80 percent of normal CAD skills. The report suggests a viable alternative is to offer CAD training on low cost CAD systems, thus saving industry half a billion dollars in training costs in just four years time.

As a result of these reports, CADAPPLEs have now been installed in New Zealand, Singapore, Japan, the Phillipines, Sweden, Monaco, Germany, Kenya, Israel, Holland, Italy, Belgium, and Portugal. American companies that are using CADAPPLEs include Morrill Electric, General Motors, TRW, the U.S. Geological Survey, and Westinghouse, to name but a few. Community colleges in California, Florida, New York, Massachusetts, Missouri, Tennessee, Iowa, Ohio, Michigan, Oregon, and Texas now use CADAPPLEs. In fact, there are now CADAPPLEs being used in schools in over half the States. Illinois' educational institutes that use CADAPPLEs (besides IVVC) include the University of Illinois, Southern Illinois University, and the Bloomington Area Vocational Center.

T & W Systems' secret to success has been constant updating of their already excellent software products while others have remained stagnant. IVVC has had their system for some time and is currently in the fourth revision of CADAPPLE software. Each new version is improved by T & W Systems based on input from their users. The Anderson Report, an independent CAD review newsletter, gave CADAPPLE systems an excellent review saying "Maybe CADAPPLE is the VisiCalc of the CAD business."

Conclusion

I have seen drafting instructors from all over this nation react to CAD. Those who have reservations fall into two main categories: those who are afraid of something this revolutionary, fearing the man versus machine dilemma, and those who want to remain progressive but are afraid of either their administrations' or board's reaction to a request for a $12,000 CAD system.

The instructors that fall into the first category can easily be understood. The future holds many unknowns when you consider that CAD, as it is used in the 21st century, may use voice input over the traditional forms of input. An eye tracking device is also being considered. This device would involve a low-level laser beam reflected from the retina of the operator's eye. Eye movements could control menu displays and other common CAD functions such as symbol manipulation and positioning of drawing primitives. A body movement detection system is also being considered as a possible alternative to today's input methods. In this mode, system body language could be translated into the graphic language.

A cognitive interface is being studied by the Hewlett Packard company which would involve attaching instrumented sensors to the operators scalp.

Instructors that feel they cannot adequately justify a CAD system to their superiors can look to a wealth of documentation on CAD systems. Several college studies are currently under way to establish the effectiveness of computer-aided design over manual drafting. These studies will focus on the cost effectiveness of CAD. It is my sincere hope that this paper, the writings listed in the Bibliography of this paper, and research now being conducted will give drafting instructors the courage to approach their superiors and request the drafting tools that will be commonplace in the very near future.

In the workforce today, it is estimated that 45 to 55 percent of the people working are in the information processing business. According to a study conducted by the Bureau of Labor Statistics, by the year 2000 that figure is expected to rise to 80 percent. According to conservative estimates, between 10,000 to 13,000 new CAD systems will be installed in 1984. If we as vocational educators will not assume the responsibility for training the new operators of these systems, just who will?

IVVC will probably continue to teach drafting basics at the drafting table with machines. As we see it, students of drafting have to learn how to "walk" with manual drafting before they can "run" with a CAD system. The future of the IVVC Drafting and Design Program holds both 3-D enhancement capabilities by the fall of 1984 and computer-aided manufacturing (CAM) by the end of 1985. We are very excited to be riding the crest of this high technology wave and we will be happy to share our excitement in the form of teacher in-service workshops and mini-training sessions in the future.

If you would like more information on the IVVC CADAPPLE turnkey CAD system, write to: Mark Schwendau, IVVC, 600 Lions Road, Sandwich, Illinois 60548.

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INTEGRATING COMPUTER-ASSISTED DESIGN (CAD) INTO THE DRAFTING CURRICULUM

SCHOOL: Wausau West High School
ADDRESS: 1200 W. Wausau Avenue Wausau, WI 54401
TELEPHONE NUMBER: (715)675-3351
INSTRUCTIONAL PROGRAM: Drafting Course in the Industrial Technology Department
CONTACT PERSON: Robert Zuleger

The Wausau School District in North Central Wisconsin has implemented two three-year plans for the integration of computer-based education into all grade levels, from elementary through high school. There are currently 285 computers in the district, which means that there is one computer for every 22 students. The programs which currently utilize computers at the high school level are business education, math and drafting. There are IBM-PC's in the business lab at each high school, Apples in the math lab, and several other "floating" computers used in selected courses, such as drafting. In the middle school lab, there are IBM-PC's and Commodore 64's. In the elementary schools, IBM computers are being used in a pilot program called "Writing to Read;" a language development program designed by IBM.

Prior to the implementation of both the first three-year plan and the second three-year plan, faculty members were asked to submit a proposal for integrating microcomputers into their curriculum. The interest of individual staff members, in combination with an assessment of available resources, determines who receives the hardware and software necessary for implementation. Within the three-year block of time, a faculty member could submit new proposals which would be funded in the middle of the three year block.

Robert Zuleger at Wausau West High School expressed an interest and documented a need for integrating computer-assisted drafting (CAD) into his drafting course. In order to receive approval for implementing the curriculum changes, he had to go to his advisory committee for support. He also involved the vocational education coordinator in his area, the school principal, and the school coordinator in the school. His proposal was supported and funded by the administration.

Teacher Inservice

The administration has supported faculty training and inservices which focus on the integration of the microcomputer into classroom management and curriculum innovations. In fact, the district is seen as a pioneer in implementing microcomputers into all facets of the curriculum.

The administration believes that innovations need to be initiated by the faculty and presented to the administration rather than from the top, down. As a result, the administration has spent time and money supporting efforts to develop their faculty's knowledge and creativity in the use of the microcomputer.

A course, "Computers in Education," has been offered to teachers in the Wausau School District since 1978 through the University of Wisconsin-Stevens Point. The course is taught by Wausau District Staff and is held in the District's labs. Approximately 85% of the teachers in Wausau have completed this three-credit graduate class. The focus of the class is, "How Computers Can Be Utilized in

Education." The course work revolves around hands-on projects. There is some programming introduced during the class. The intent is not to convert teachers into programmers but to have them become familiar with the technology and its impact on education. Units covered include:

1. Social Implications,
2. Educational Impact (How to Evaluate, Resources Available, How They Affect the Way We Work), and
3. Beginning Programming and General Literacy.

Selected readings during the course include Micro Millenium, Megatrends, and Mind Storm (LOGO), in addition to numerous journal articles. A variety of computers are used in the course so that teachers can understand the ease with which a user can move from one machine to the next with only minimal adjustments in the knowledge base. In other words, the course is not taught as a "machine-specific" course but as a general literacy course.

After taking the course, teachers are encouraged to pursue their own ideas regarding the best way to integrate the microcomputer into their class.

In addition to this general inservice, the administration supports professional development activities related to specific interests and needs. For example, in order to prepare for integrating the microcomputer into the drafting course, the instructor was sent to the Milwaukee Area Technical College for training in the MATC-CAD curriculum and manual, developed for use on the Apple. He is currently using their software in his class.

The Curriculum

The competencies and tasks of the Mechanical Drafting Course follow: (NOTE #28 in the list of Competencies and Task Detailing Sheet.)

MECHANICAL DRAFTING COMPETENCIES

1. Make freehand sketches
2. Do freehand, single stroke gothic lettering
3. Select and use drafting tools and media
4. Select and use drafting scales
5. Draw appropriate lines for mechanical drawing
6. Draw geometric construction
7. Draw multi-views of objects
8. Dimension mechanical parts
9. Draw pictorial representations
10. Operate reproduction equipment
11. Draw auxiliary views
12. Draw sectional views
13. Understand manufacturing processes
14. Use inking tools and transfer materials
15. Solve descriptive geometry problems
16. Draw standard fasteners
17. Draw various maps
18. Draw hydraulic diagrams
19. Draw cams
20. Make detail drawings
21. Draw piping diagrams
22. Make welding drawings
23. Draw gears
24. Make assembly drawings
25. Read and draw engineering charts and graphs
26. Make electrical drawings
27. Apply design steps
28. Draw using computer-aided drafting

MECHANICAL DRAFTING COMPETENCIES & TASKS

1. Make Freehand Sketches.

    1.1) Select proper equipment
    1.2) Select proper media
    1.3) Use proper strokes
    1.4) Maintain proper proportions
    1.5) Sketch multiviews
    1.6) Sketch pictorial views
    1.7) Apply shading
    1.8) Select appropriate type of sketch

2. Do Freehand, Single Stroke Gothic Lettering.
    - 2.1) Use guideline device
    - 2.2) Proper forming of letter and numerals
    - 2.3) Use guideline devices
3. Select and Use Drafting Tools and Media.
    - 3.1) Proper selection and shaping of drafting lead
    - 3.2) Choose the proper drafting media
    - 3.3) Draw vertical, horizontal, and angle lines
    - 3.4) Operate drafting machines
    - 3.5) Draw circle and arcs using the compass
    - 3.6) Proper use of dividers
    - 3.7) Use the eraser shield
    - 3.8) Draw with templates
    - 3.9) Use irregular curves
    - 3.10) Draw and measure given angles using the protractor
    - 3.11) Use eraser and cleaning devices
4. Select and Use Drafting Scales.
    - 4.1) Identify the relationship between scale and true size
    - 4.2) Identify the basic shapes of scales
    - 4.3) Identify the basic types of scales
    - 4.4) Lay out and measure lines with a mechanical engineer's scale
    - 4.5) Lay out and measure lines with an architect's scale
    - 4.6) Lay out and measure lines with a metric scale
    - 4.7) Use the scales properly
5. Draw Appropriate Lines for Mechanical Drafting.
    - 5.1) Draw construction lines
    - 5.2) Identify and draw visible lines
    - 5.3) Identify and draw hidden lines
    - 5.4) Identify and draw center lines
    - 5.5) Draw dimension and extension lines
    - 5.6) Draw leader lines
    - 5.7) Select and draw section lines
    - 5.8) Select and draw cutting plane lines
    - 5.9) Select and draw breaklines
    - 5.10) Identify and draw a phantom line
6. Draw Geometric Construction.
    - 6.1) Identify terms & symbols
    - 6.2) Bisecting geometric figures
    - 6.3) Divide a line into equal parts
    - 6.4) Construct geometric figures
    - 6.5) Draw tangents
    - 6.6) Locate the center of a circle

7. Draw Multi-Views of Objects.

    7.1) Define terms used in multi-view drawings
    7.2) Projection of depth dimension
    7.3) Construct multi-view drawings

8. Dimension Mechanical Parts.

    8.1) Properly use the terms associated with dimensioning
    8.2) Select dimensions needed
    8.3) Understand and apply dimensioning rules
    8.4) Plan the location of dimensions
    8.5) Select type of dimensions
    8.6) Utilize tolerances
    8.7) Apply datum dimensions
    8.8) Apply surface finish marks

9. Draw Pictorial Representations.

    9.1) Identify common types of pictorial drawings
    9.2) Draw isometric objects
    9.3) Draw general oblique
    9.4) Draw cabinet oblique
    9.5) Draw one-point perspective
    9.6) Draw two-point perspective

10. Operate Reproduction Equipment.

    10.1) Identify types of reproduction processes
    10.2) Operate whiteprint machine
    10.3) Produce a sepia
    10.4) Know requirements for a print

11. Draw Auxiliary Views.

    11.1) Identify relationship between auxiliary and regular views
    11.2) Project to and from primary auxiliary views
    11.3) Draw secondary auxiliaries
    11.4) Draw revolutions

12. Draw Sectional Views.

    12.1) Select type of section lines
    12.2) Draw full sections
    12.3) Draw half sections
    12.4) Draw offset section
    12.5) Draw revolved section
    12.6) Draw rib and webs
    12.7) Draw a removed section
    12.8) Draw broken out section
    12.9) Draw sectioned assembly drawings

13. Understand Manufacturing Processes.

    13.1) Explain the casting process
    13.2) Explain machining operations

14. Use Inking Tools and Transfer Materials.

    14.1) Using technical pens
    14.2) Use lettering set
    14.3) Select and apply transfer materials

15. Solve Descriptive Geometry Problems.

    15.1) Find true length of a line
    15.2) Find piercing point
    15.3) Find true angle
    15.4) Find true shape

16. Draw Standard Fasteners.

    16.1) Interpret standard fastner tables
    16.2) Draw studs
    16.3) Draw cap screws
    16.4) Draw machine screw
    16.5) Draw set screws
    16.6) Draw nuts and bolts
    16.7) Draw keys
    16.8) Draw pins
    16.9) Draw washers
    16.10) Define thread terminology
    16.11) Draw thread symbols

17. Draw Various Maps.

    17.1) Apply terms associated with mapping
    17.2) Draw contour maps
    17.3) Draw a lot layout
    17.4) Draw sections
    17.5) Use transit
    17.6) Read vernier

18. Draw Hydraulic Diagrams.

    18.1) Apply proper symbols
    18.2) Select appropriate diagram to be used from four types
    18.3) Construct a hydraulic circuit
    18.4) Calculate PSI and distance traveled
    18.5) Use vendor catalogs

19. Draw Cams.

    19.1) Identify cam types, motion and nomenclature

- 19.2) Design and draw a cam which incorporated uniform motion, or harmonic, or uniformly accelerated motion, or a combination of two motions
- 19.3) Select which type of cam movement to use

20. Make Detail Drawings.

- 20.1) Make detail drawing from given directions
- 20.2) Select proper type of drawing
- 20.3) Apply dimensions

21. Draw Piping Diagrams.

- 21.1) Properly use terms associated with piping
- 21.2) Identify basic piping symbols
- 21.3) Draw a single line piping drawing
- 21.4) Draw a pictorial drawing

22. Make Welding Drawings.

- 22.1) Understand common methods of welding
- 22.2) Identify basic types and sizes of joints and represent them by symbols

23. Draw Gears.

- 23.1) Identify common gear types
- 23.2) Identify spur gear nomenclature
- 23.3) Make working drawing of spur gears

24. Make Assembly Drawings.

- 24.1) Recognize different types
- 24.2) Drawing assembly drawing

25. Read and Draw Engineering Charts and Graphs.

- 25.1) Identify classification of charts
- 25.2) Draw charts

26. Make Electrical Drawings.

- 26.1) Draw block diagrams
- 26.2) Draw schematic diagrams

27. Apply Design Steps.

- 27.1) Understand design terms
- 27.2) Use design process

28. Draw Using Computer-Aided Drafting

- 28.1) Name parts of computer graphics system
- 28.2) Use computer graphic terms

28.3) Use the syntax of a typical graphics command
28.4) Give graphic commands
28.5) Use screen control commands
28.6) Apply grids and coordinates
28.7) Insert lines
28.8) Insert circles, arcs and points
28.9) Insert dimensions and text
28.10) Use verification and measurement command
28.11) Use entity modification
28.12) Use layering

Discipline Area *MECHANICAL DRAFTING* Code Number *28*

TASK DETAILING SHEET

Competency *Draw Using Computer-Aided Drafting*

Task To Be Performed To Achieve Competency	Type of Perform.	Learning Diff.	Program Level
28.1 Name parts of computer graphics system A. central processing unit B. plotter C. digitizer D. design station E. storage device			C D
28.2 Use computer graphic terms A. cursor B. default valve C. digitizing D. entity E. mask F. prompt			C D
28.3 Use the syntax of a typical graphics command A. verb B. noun C. modifier			C D
28.4 Give graphic commands A. line B. circles C. points			C D

Type of Performance:

A. Recall
B. Manipulation
C. Discrimination
D. Problem Solving

Learning Difficulty:

A. Easy
B. Moderately Difficult
C. Very Difficult
(Special mark where student can already perform task)

Program Level:

A. Exploratory - Middle School
B. Beginning - Introductory
C. Intermediate
D. Advanced
E. Occupational

Discipline Area *MECHANICAL DRAFTING* Code Number *28*

TASK DETAILING SHEET

Competency *Draw Using Computer-Aided Drafting*

Task To Be Performed To Achieve Competency	Type of Perform.	Learning Diff.	Program Level
D. fillets			
E. text			
F. dimensions			
28.5 Use screen control commands			D
A. zoom			
B. page			
28.6 Apply grids and coordinates			D
A. cartesian			
B. polar			
C. grids			
28.7 Insert lines			C D
A. horizontal and vertical			
B. perpendicular			
C. parallel			
D. tangent			
E. angle			
F. center lines			
28.8 Insert circles, arcs and points			D
A. circles			
B. arcs			
C. points			

Type of Performance:	Learning Difficulty:	Program Level:
A. Recall	A. Easy	A. Exploratory - Middle School
B. Manipulation	B. Moderately Difficult	B. Beginning - Introductory
C. Discrimination	C. Very Difficult	C. Intermediate
D. Problem Solving	(Special mark where student can already perform task)	D. Advanced
		E. Occupational

Discipline Area *MECHANICAL DRAFTING* Code Number *28*

TASK DETAILING SHEET

Competency *Draw Using Computer-Aided Drafting*

Task To Be Performed To Achieve Competency	Type of Perform.	Learning Diff.	Program Level
D. fillets			
28.9 Insert dimensions and text			D
A. linear			
B. radial			
C. diameter			
D. angular			
E. select text			
F. insert text			
G. changing text			
28.10 Use verification and measurement command			D
A. verify			
B. measure			
28.11 Use entity modification			D
A. trim			
B. measure			
C. mirroring			
D. moving			
E. rotation			
28.12 Use layering			D
A. select layering			
B. change layer			

Type of Performance:	Learning Difficulty:	Program Level:
A. Recall	A. Easy	A. Exploratory - Middle School
B. Manipulation	B. Moderately Difficult	B. Beginning - Introductory
C. Discrimination	C. Very Difficult	C. Intermediate
D. Problem Solving	(Special mark where student can already perform task)	D. Advanced
		E. Occupational

Although the competency that is related to microcomputers is listed at the end of the list, the computers are used every day in the drafting course. There are currently four Apple IIe's in the classroom, each with 64K. Each computer also has a graphics tablet and two drives. Other hardware includes two Epson printers and two Hewlett-Packard plotters. They are used in two capacities. The first involves the CAD application. The materials developed at the Milwaukee Area Technical College, MATC-CAD, are used. The materials include a manual and diskettes. Introductory guides for the teacher along with assignments, test questions, and sample problems are included in the manual. According to Zuleger, it is an excellent manual/text. In order to use the material, however, it is necessary for the instructor to spend one week in training with the developers.

In addition to illustrating concepts taught in a traditional drafting curriculum, the microcomputer is used to complete assignments and point out capabilities and limitations of this new technology. When a curriculum unit is introduced, the instructor not only teaches the new concepts as done previously but also demonstrates to the class how the new concepts can be applied vis a vis the microcomputer. Assignments are then made which will develop mastery of that competency both on and off the computer. Fitting all the lessons that are included in MATC-CAD into the already-existing curriculum is difficult, so choices need to be made by the instructor regarding the importance of the new concepts. Students have two weeks to complete their assignments during classroom time or open lab time.

The schedule at Wausau West is modular so it is easy for students to come to the drafting class during their free time to work on projects.

The second use of the Apples involves other software such as Heat Loss Determination Programs, Architectural Drafting, drill and practice programs and general problem-solving packages. There are also tutorial programs available for remedial work in Measuring. A diskette on computer literacy from the Apple Corporation is available but most of the students have had quite a bit of exposure to microcomputers before they enroll in this class.

Programming is not taught in any of the industrial technology courses. They are application-oriented only.

Evaluation

The role of the microcomputer has not been the sole focus of an evaluation because it has been interwoven into an already-existing curriculum. Thus, it is only one component of a larger evaluation.

The biggest problem that the instructor has encountered when introducing the computer, is the limited amount of hardware available. As a result, assignments must be spread over a long period of time so that students will have access to the machines to complete the assignments. Valuable time is lost while waiting for students to finish their work.

The Future

The Wausau School District's next major step in computer-based education will be to open a Computer Resource Center in the high schools attached to the library. It will be run as an open lab where students can complete projects in a variety of disciplines, including computer-assisted drafting, music, foreign languages, art, etc. They also hope to have the capability in the lab of accessing a national database through modems attached to the microcomputers.

A STATEWIDE DEMONSTRATION SITE FOR TEACHING CAD

SCHOOL: Mission Bay High School
ADDRESS: 2475 Grand Avenue, San Diego, CA 92109
TELEPHONE NUMBER: (619)270-2790
PROGRAM: Computer-Assisted Design (CAD)
CONTACT PERSON: Stuart Noderer

Mission Bay High School in San Diego, California has been chosen as a statewide demonstration site for teaching Computer-Assisted Design. Along with this comes the responsibility to provide inservices for teachers and display a variety of optional equipment illustrating the various uses of CAD equipment in the curriculum at the secondary level.

The coordinator of the program started to research CAD equipment approximately six years ago. He selected an Apple Computer and its graphics tablet, including the Designers Tool Kit by Apple (from Delivery Software in Cupertino, California). He also put together a flatbead plotter which although is not a real successful interface, it does demonstrate the necessary principles. In addition to that equipment, he now has six additional computers for the demonstration site, including one IBM and five Apple computers. Purchases were made with VEA monies set aside to create demonstration sites, not district dollars.

As a demonstration site, it was necessary to have a variety of software available to demonstrate and use. The coordinator has purchased new software from T & W, and recently purchased MATCAD software from the Milwaukee Area Technical College in Wisconsin. He has freedom to choose the software that he feels will fit best into the demonstration site. A word processing package and Visicalc are also used to teach computer literacy and do in-services for teachers.

All efforts are not directed towards integrating CAD into drafting programs. The coordinator has a dual role as an active member on the committee to help get computer literacy into the school. Money was received from the state, in addition to the vocational education monies, for a three-year program to train teachers in all subject areas.

Use In The CAD Class

Students in the drafting program are at three different levels. There are beginning drafting students, second year drafting students and vocational students. Noderer has been using the computer to teach CAD at all three levels. Training of drafting students is housed within a regional vocational program; students from other high schools also come to the classes for CAD instruction.

In the beginning class, he uses two systems of teaching. One week per semester (10 hours per year) students complete their drawings on the computer. The computer is presented as a substitute tool for completing projects. The computers are in an open lab which is scheduled on rotating cycles for students.

Advanced students assist in each class and orient students to the computer. Much of the learning is by trial and error during their one week of drawing on the computer. The advanced students also demonstrate the use of the computer in word processing and spreadsheet analysis to the whole class, but again projects can only be completed in the open lab when it is available.

Now that new software and hardware has arrived, the curriculum will be changed so that each student has twice as much time on the computer. Students will be able to rotate so that they can stay on for one month. They not only will have more time on the computer but, with the new equipment, they can more accurately duplicate industry processes. The program has purchased a better plotter and uses MATCAD (which does an excellent job of imitating the processes of larger machines commonly found in industry but too expensive for the classroom). On both the Apple and IBM, there are worksheets from T & W systems which include a series of exercises teaching insertion commands, saving, making drawings and completing changes on those drawings. Software used on the IBM is Versa CAD; on the Apple, Apple CAD is used, (both from T & W).

Two general principles direct the curriculum. One, it is important to show students the variety of ways to complete a project. Two, the students also need to understand the concept of "flexibility," meaning that drafting is a dynamic and changing field; a fact which will be confronted by every student in the drafting programs.

There are approximately 30 students at the beginning drafting level (their sophomore and junior year in high school); 23 at the second level of drafting (senior year in high school); 24 in the architecture class, and 24 students in the ROP vocational class (two hours a day)—a time when students from the region come in just to study drafting in the high school. It should be noted that the San Diego schools have a magnet school system in which students are bused to area schools where the curriculum of interest is located. Mission

Bay High School is the magnet school for marketing, management, graphics and design. This means that students can either come to the school for all three years of high school, come for the management and graphics classes for a full day, or to the ROP classes only to study selected topics such as drafting.

The microcomputers are also being used for CAI. Drill and practice programs are used for remedial work, and concepts covered in class are reviewed during class or open lab time. Tutorial programs are not used in the curriculum.

Evaluation

It has been found that the microcomputer is a great motivator. The students are excited and find that working with the microcomputer is very rewarding in that it encourages individual creativity.

Students generally work alone on their projects, so changes in social relationships between students have not changed much as a result of microcomputer use.

In the long run, the microcomputer also helps instructors feel enthusiastic and motivated because it "gives teachers an opportunity to learn and be creative while teaching in a new and different way." The only problem encountered has been the "time" factor. The instructor in the CAD program is the only one of "his kind" in the school and it takes time to teach and prepare lessons for the entire school, while maintaining an innovative demonstration site for the state.

GENERATING TESTS WITH A MICROCOMPUTER

SCHOOL: Vincennes University
ADDRESS: Vincennes, Indiana 47519-9986
TELEPHONE NUMBER: (618)884-9049
INSTRUCTIONAL PROGRAM: Aviation Maintenance Technology
CONTACT PERSON: Walter Hollingsworth

Vincennes University's Aviation Maintenance Technology Program uses microcomputers two ways within their curriculum. One is the Computer Generated Testing Program which instructors use to produce classroom-style exams. The other is called the Intest Program. Students can use this program to independently prepare for an exam outside the structured classroom.

Computer Generated Testing Program

The Computer Generated Testing Program utilizes over 6,000 multiple choice questions. Each question is stored in the computer under an "objective number" which identifies the subject matter covered by the question (See Figure 1). To generate an exam, the instructor selects the objectives s/he wishes to test and then designates the number of questions needed for each objective. The computer then selects the required questions at random and prints the exam. It is then duplicated and given to the students. After the test has been completed, the computer grades the answer sheets. The students' scores are automatically recorded by the computer. In addition, the computer analyzes the test results, providing the instructor with valuable statistical information, including an item analysis.

FIGURE 1

Sample Test
**** TEST NUMBER 605 ****
Bud Hollingsworth
TAM 150
SHEET METAL STRUCTURES

(1) (3, 5, 1134)
What should be the included angle of a twist drill for soft metals?
1. 45 degrees
2. 65 degrees
3. 90 degrees
4. 118 degrees

(14 , par, 115) 65-21, p. 32, Q, 124

(2) (4, 5, 1134)
Select the alternative which best describes the function(s) of the flute section of a twist drill:
1. Allows lubrication to reach the point (when necessary)
2. Curls the chips tightly within themselves to avoid clogging the hole being drilled
3. Forms the cutting edges of the point and provides a channel whereby the chips can escape from the hole
4. All of the Above

(14, par, 115)

(3) (1, 5, 1136)
Which of the following statements is correct concerning the use of a metal file?
1. A file with an integral handle is referred to as a safe-edge file
2. Apply pressure on the forward stroke only, except when filing very soft metals such as lead or aluminum
3. A smoother finish can be obtained by using a double-cut file than by using a single-cut file
4. The terms "double-cut" and "second-cut" have the same meaning in reference to files

(4) (1, 5, 1146)
Longitudinal (fore and aft) structural members of a semimonocoque fuselage are called:
1. Longerons and stringers
2. Spars and ribs
3. Bulkheads and rings
4. Ribs and formers

(14, par, 115)

(5) (2, 5, 1148)
What type of wing design requires no external bracing?
1. Cantilever design
2. Multispar wing construction
3. Stressed skin wing design
4. Semicantilever design

(14, par, 115) 65-21, P, 30, Q, 114

(6) (1, 5, 1152)
When comparing the machining techniques, for stainless steel sheet material to those for aluminum alloy sheet, it is normally considered good practice to drill the stainless steel at a

1. Higher speed with less pressure applied to the drill
2. Lower speed with more pressure applied to the drill
3. Higher speed with more pressure applied to the drill
4. Lower speed with less pressure applied to the drill

(14, par, 115) 65-21, P, 32, Q, 123

(7) (1, 5, 1158)
Repairs or splices involving stringers on the lower surface of stressed skin metal wings are usually:

1. Not permitted
2. Permitted but are normally more critical in reference to strength in tension than similar repairs to the upper surface
3. Permitted but are normally more critical in reference to aerodynamic cleanness than similar repairs to the upper surface
4. Permitted only if the damage does not exceed six inches in any direction

(14, par, 115)

(8) (1, 5, 1171)
What is the purpose of a gusset or gusset plate used in the repair and construction of aircraft?

1. To provide access for inspection of structural attachments
2. To provide a method of adjusting the tension or location of structural components
3. To join and reinforce intersecting structural members
4. To hold structural members in position temporarily until the permanent attachment has been completed

(9) (1, 5,1180)
Aircraft structural units, such as spars, engine supports, etc., which have been built up from sheet metal are normally:

1. Repairable, except when subjected to compressive loads
2. Repairable, using approved methods
3. Not repairable, but must be replaced when damaged or deteriorated
4. Repairable, except when subjected to tensile loads

(14, par, 115)

(10) (1, 5, 1182)
Shallow scratches in sheet metal may be repaired by

1. Burnishing
2. Stop drilling
3. Patching
4. Buffing

(14, par, 115) 65-21, P, 32, Q, 125

(11) (1, 5, 1184)
Which of the following statements is true regarding the inspection of a stressed-skin metal wing assembly known to have been critically loaded?

1. If rivets show no visislble distortion, further investigation is not necessary
2. If bearing failure has occurred, the rivet shanks will be joggled
3. If shear failure has occurred, the sheet will be distorted from the rivet holes out to the edge of the sheet
4. If genuine rivet tipping has occurred, groups of consecutive rivet heads will be tipped in the same direction

(14, par, 115)

(12) (1, 5, 1186)
Which procedure is correct when using a reamer to finish a drilled hole to the correct size?

1. Apply considerable pressure on the reamer when starting the cut and reduce the pressure when finishing the cut
2. Use a high viscosity cutting oil to lubricate the reamer
3. Turn the reamer in the cutting direction when enlarging the hole and in the opposite direction tc remove from the hole
4. Turn the reamer only in the cutting direction

(14, par, 99) 65-21, P, 30, Q, 1112

(13) (2, 5, 1216)
What is a joggle?

1. A flanged angle formed by cutting
2. An offset formed on an angle strip
3. A hole cut in rib section or fuselage frame
4. A flanged angle formed by shrinking

(13, par, 162)

(14) (1, 5, 1220)
Hammering, striking, or rolling used to form an aluminum alloy sheet into the desired shape normally causes it to become

1. Harder, stronger, and more brittle
2. More coarse in crystalline structure
3. More ductile and more resistant to deformation
4. More brittle with an accompanying loss of tensile strength

65-21, P37, Q, 166

(15) (1, 5, 1222)
When bending metal, the material on the outside of the curve stretches while the material on the inside of the curve compresses. That part of the material which is not affected by either stress is the:

1. Bend tangent line
2. Neutral line
3. Mold line
4. Set back line

(13, par, 147)

(16) (1, 5, 1224)
A piece of sheet metal is bent to a certain radius. The curvature on the bend is referred to as the
1. Bend radius
2. Bend line
3. Bend allowance
4. Neutral line
(13, par, 147) 65-21, P36, Q, 158

(17) (2, 5, 1226)
The amount of material required to make the 90 degree bend shown in the drawing is:
1. 0.1717 inches
2. 0.3434 inches
3. 0.3925 inches
4. 0.8397 inches
(13, par, 147)
(See page 49, Diagram book)

(18) (1, 5, 1228)
A piece of flat stock that is to be bent to a closed angle of 15 degrees must be bent through an angle of
1. 165 degrees
2. 105 degrees
3. 75 degrees
4. 15 degrees
(13, par, 146) 65-21, P, 36, Q, 164

(19) (1, 5, 1230)
The sharpest bend that can be placed in a piece of metal without critically weakening the part is called the
1. Bend allowance
2. Minimum radius of bend
3. Maximum radius of bend
4. Neutral radius of bend
(13, par, 146) 65-21, P36, Q, 159

(20) (1, 5, 1232)
When a piece of aluminum alloy is to be bent using a minimum radius for the type and thickness of material
1. The piece should be bent slowly to eliminate cracking
2. Less pressure than usual should be applied with movable (upper) clamping bar
3. The movable (upper) clamping bar should be moved back from the working face of the bending leaf
4. The layout should be made so that the bend will be 90 degrees to the grain of the sheet
(13, par, 146) 65-21, P36, Q, 163

There are five levels of questions in the files. The first level contains questions created by instructors, including those sent by other schools represented on the Aviation Technicians Education Council (ATEC). The second, third and fourth levels are not currently in use but will eventually contain items of varying difficulty levels. They will be sorted out into these levels over time. The fifth level contains questions written by the Federal Aviation Administration (FAA) that were obtained from the Certification Test study guides. (All questions are organized by objective.)

Figure 2

SAMPLE LIST OF OBJECTIVES COVERED ON THE TEST

OBJECTIVE	GROUP	TEST: 676	ITEM NO. 9
1304	5		
1306	5		
1308	5		
1312	5		
1314	5		
1314	5		
1314	5		
1318	5		
1320	5		
1322	5		

Figure 3

SAMPLE TEST ANSWER KEY

```
Q#  1 Group 5 Keyed to 1134 Needs 1 Answer=3 Q# 3
Q#  2 Group 5 Keyed to 1134 Needs 1 Answer=4 Q# 4
Q#  3 Group 5 Keyed to 1136 Needs 1 Answer=2 Q# 1
Q#  4 Group 5 Keyed to 1146 Needs 1 Answer=1 Q# 1
Q#  5 Group 5 Keyed to 1148 Needs 1 Answer=1 Q# 2
Q#  6 Group 5 Keyed to 1152 Needs 1 Answer=2 Q# 1
Q#  7 Group 5 Keyed to 1158 Needs 1 Answer=2 Q# 1
Q#  8 Group 5 Keyed to 1171 Needs 1 Answer=3 Q# 1
Q#  9 Group 5 Keyed to 1180 Needs 1 Answer=2 Q# 1
Q# 10 Group 5 Keyed to 1182 Needs 1 Answer=1 Q# 1
Q# 11 Group 5 Keyed to 1184 Needs 1 Answer=4 Q# 1
Q# 12 Group 5 Keyed to 1186 Needs 1 Answer=4 Q# 1
Q# 13 Group 5 Keyed to 1216 Needs 1 Answer=2 Q# 2
Q# 14 Group 5 Keyed to 1220 Needs 1 Answer=1 Q# 1
Q# 15 Group 5 Keyed to 1222 Needs 1 Answer=2 Q# 1
Q# 16 Group 5 Keyed to 1224 Needs 1 Answer=1 Q# 1
Q# 17 Group 5 Keyed to 1226 Needs 1 Answer=2 Q# 2
Q# 18 Group 5 Keyed to 1228 Needs 1 Answer=1 Q# 1
Q# 19 Group 5 Keyed to 1230 Needs 1 Answer=2 Q# 1
Q# 20 Group 5 Keyed to 1232 Needs 1 Answer=4 Q# 1
```

The program is able to record grades, do an item analysis (indicating which instructors are doing a good job teaching their objectives), and an objective analysis which lists the students who passed the test and those who failed with their scores (See Figures 4, 5, 6, 7, & 8).

Figure 4

COMPUTER GENERATED EXAM STATISTICS LISTING

```
                                          LIST 1

                               RAW      %         #     %
                       ID     SCORE   SCORE      OBJ  OBJECT

Andrews, Scott          4      20      83.8       19   90.5
Baseley, David          6      17      70.8       15   71.4
Boenitz, Thomas        10      17      70.8       17   81.0
Boots, Robert          12      20      83.8       17   81.0
Bower, Blake           14      16      66.7       15   71.4
Bryant, Brian          18      18      75.0       16   76.2
Burns, John            20      16      66.7       14   66.7
Butcher, Brian         22      14      58.3       14   66.7
Byfeild, Michael       24      13      54.2       13   61.9
Carlisle, Terry        26      13      54.2       12   57.1
```

LIST 2

RAW SCORE	FREQ	CUM FREQ	PERC RANK	STD SCORE
20	3	20	99	53
19	2	17	84	52
18	1	15	74	51
17	2	14	69	51
16	5	12	59	50
15	2	7	34	49
14	2	5	24	48
13	2	3	14	48
12	0	1	4	47
11	1	1	4	46

LIST 3

*** SUMMARY STATISTICS ***

Items = 24
Students = 20
Std Dev = 13.16
Mean = 16.25

Maximum = 20
Minimum = 11
Mode = 16
Median = 15.60
Range = 10

LIST 4

*** GROUP STATISTICS ***

	Percent Students	Number Students	Mean Score	Max Score	Min Score
Total	100	20	16.25	20	11
Upper	28	5	19.60	20	19
Lower	28	5	13.00	14	11

```
                                LIST 5

                   *** ITEM CHARACTERISTICS ***

      CORRECT           RESPONSE              ITEM    DISC
Q#    ANSWER          DISTRIBUTION            DIFF    INDEX    Q#   OBJECTIVE
                 0    1    2    3    4    5

 1       3       0    0    0   12    8    0  0.600   0.536    3       1134
 2       4       0    0    1   10    9    0  0.450   0.0      4       1134
 3       2       0    3   12    4    1    0  0.600   0.893    1       1136
 4       1       0   17    1    1    1    0  0.850   0.179    1       1146
 5       1       0   12    0    8    0    0  0.600   0.357    2       1148
 6       2       0    2   10    3    5    0  0.500   0.536    1       1152
 7       2       1    1   11    3    4    0  0.550   0.357    1       1158
 8       3       0    5    0   14    1    0  0.700   0.0      1       1171
 9       2       0    0   16    3    1    0  0.800   0.357    1       1180
10       1       0   20    0    0    0    0  1.000   0.0      1       1182
11       4       0    0    0    6   14    0  0.700   0.536    1       1184
12       4       0    0    1    1   18    0  0.900   0.357    1       1186
13       2       0    0   19    0    1    0  0.950   0.0      2       1216
14       1       0    5    1    3   11    0  0.250   0.0      1       1220
15       2       0    3   13    4    0    0  0.650   0.357    1       1222
16       1       0   17    0    3    0    0  0.850   0.0      1       1224
17       2       0    0   20    0    0    0  1.000   0.0      2       1226
18       1       0   19    0    0    1    0  0.950  -0.179    1       1228
19       2       0    2   14    4    0    0  0.700   0.536    1       1230
20       4       0    6    1    4    9    0  0.450   0.357    1       1232
21       3       0    0    9    7    4    0  0.350   0.357    1       1234
22       4       0    3    2    1   14    0  0.700   0.179    3       1234
23       1       0   18    0    2    0    0  0.900   0.0      4       1234


                                LIST 6

                       *** ITEM ANALYSIS ***

      ITEM DIFFICULTY                       ITEM DISCRIMINATION
        DISTRIBUTION                            DISTRIBUTION

              NUMBER     PRCNT                        NUMBER     PRCNT
RANGE        OF ITEMS   OF ITEMS          RANGE      OF ITEMS   OF ITEMS

.81 - 1.00      8          33             .81 - 1.00     1          4
.61 -  .80      6          25             .61 -  .80     0          0
.41 -  .60      7          29             .41 -  .60     4         16
.21 -  .40      3          12             .21 -  .40     7         29
.00 -  .20      0           0             .00 -  .20    11         45
                                          BELOW  .00

MEAN DIFFICULTY = 0.677                   MEAN DISCRIMINATION = 0.246
```

Figure 5

COMPUTER STUDENTS FILE TEST SCORES LISTING

ID	Name	Average	Score
4	Andrews, Scott	83.00	83
6	Baseley, David	71.00	71
8	Bates, Randal	0.00	0
10	Boenitz, Thomas	71.00	71
12	Boots, Robert	83.00	83
14	Bower, Blake	67.00	67
16	Boyer, Tom	0.00	0
18	Bryant, Brian	75.00	75
20	Burns, John	67.00	67
21	Burns, Richard	0.00	0
22	Butcher, Brian	58.00	58
24	Byfeild, Michael	54.00	54
26	Carlisle, Terry	54.00	54

Figure 6

COMPUTER STUDENT FILE PROGRESS REPORT

ID	Name	# OBJ	% DONE
2	Allen, Richard	0	0.0
4	Andrews, Scott	27	90.00
6	Baseley, David	25	83.33
8	Bates, Randal	0	0.0
10	Boenitz, Thomas	26	86.67
12	Boots, Robert	27	90.00
14	Bower, Blake	24	80.00
16	Boyer, Tom	0	0.0
18	Bryant, Brian	25	83.33
20	Burns, John	25	83.33
21	Burns, Richard	0	0.0
22	Butcher, Brian	22	73.33
24	Byfeild, Michael	20	66.67
26	Carlisle, Terry	19	63.33

Figure 7

COMPUTER STUDENT FILE LISTING OF OBJECTIVES NOT COMPLETED

2 ALLEN, RICHARD	INCOMPLETED OBJECTIVES
Select and use twist drills	1134
Select and use a hand file for soft metals	1136
Prepare dissimilar metals for assembly	1138
Determine type, size, and number of rivets for use in a repair	1140
Repair sheet-metal flight control surfaces	1142
Loads acting upon a semimonocoque fuselage	1144
Construction characterisitcs of monocoque and semimonocoque aircraft structures	1146
Construction characterisitcs of cantilever wing structures	1148
Types of loads carried by wing spars	1150
Drill holes in stainless steel	1152
Define bearing failure as realted to sheet metal structures	1154
Define shear failure	1156
Repair a hole in a stressed-skin metal wing	1158
Repair a section of damaged skin using a single-lap splice sheet	1160
Construct a watertight joint	1162
Countersink a hole	1164
Perform the dimpling process	1166
Select the correct rivet to accomplish a repair using a specified material	1168

Figure 8

PARTIAL COMPUTER LISTING OF COMPLETED OBJECTIVES

Objective	Completed By	Completed By
1134	17	56.67%
1136	12	40.00%
1138	0	0.0 %
1140	18	60.00%
1142	0	0.0 %
1144	0	0.0 %
1146	17	56.67%
1148	12	40.00%
1150	0	0.0 %
1152	10	33.33%
1154	0	0.0 %
1156	0	0.0 %
1158	11	36.67%
1160	0	0.0 %
1162	0	0.0 %
1164	0	0.0 %
1166	0	0.0 %
1168	0	0.0 %
1170	0	0.0 %
1171	14	46.67%
1172	20	66.67%
1174	0	0.0 %
1176	0	0.0 %
1178	0	0.0 %

Intest Program

The Intest Program makes use of the same bank of recorded questions as the Computer Generated Testing Program. The questions at all levels are mixed together. A variation of the "Shell Game" from Apple Computer was used to program the information. With this program the student tells the computer the objective s/he wants to study. A search is made and appropriate questions and answers are listed (See Figure 9). Intest is designed for use by the individual student. The student is simply selecting the objective (subject matter) to be reviewed and studied. A question is selected at random and displayed by the computer. The student is given two chances to answer the question correctly. If the student fails to answer the question in two tries, the computer displays the correct answer. The student can then request the display of an explanatory paragraph, or continue with more questions (See Figure 10). A computer log is kept of each student's time on the computer and objectives studied (See Figure 11).

Figure 9

HOW TO USE INTEST

STEP ONE: Turn the computer terminal and modem on. Lift telephone receiver, listen for dial tone, then place receiver on modem with cord end away from indicator light(s). Dial 5266. When the "ready" light on the modem comes on, the computer will print:
* MUSIC @ VINCENNES UNIVERSITY SIGN ON.

STEP TWO: Type IN /ID T001AM, and press return. This must be typed exactly as it appears here: There must be a slash at the beginning, there must be a space between the "D" and the first "T," and the two 0's must be zeros, not capital letter O's. The computer will print:
*PASSWORD?

STEP THREE: Type in music, and press return. The computer will print:
*CODE LAST USED 00.00 00MONTH83
*SIGN ON DAT MON 00,1983 TIME=00:00 PORT=000 RESTART=000
Welcome to VM/MUSIC ON IBM 4331

VINCENNES UNIVERSITY MANAGEMENT INFORMATION CENTER
(NOTE: There will follow a message to all users from the management information center. These messages vary almost daily. Be sure to wait until the computer has finished printing before you try to make an entry.)
There will be a slight pause; then the computer will print:
AVIATION STUDENT AID PROGRAMS
HELLO, WHAT IS YOUR NAME?

STEP FOUR: Type in your first name only, and press return. The computer will print:

```
PLEASE ENTER YOUR STUDENT ID:
```

STEP FIVE: Type in the identification number that you use for computer tests in the classroom, and press return. The computer will print:

```
ENTER 1:  TO STUDY OBJECTIVES
      2:  TO LOOK AT GRADES
      3:  TO END SESSION CHOICE?
```

STEP SIX: Type in the number that corresponds to the part of the program you want to use, and press return. Entering a "3" at this point cancels the program and signs you off the computer.

NOTE: Here follow two separate sets of instructions. Part "A" describes how to study the aviation maintenance objectives. Part "B" describes how to check your test scores. The numbering of the steps continues from above.

INSTRUCTIONS PART "A"
INTERACTIVE STUDYING

STEP SEVEN: To study the aviation maintenance objectives, type in a numeral 1, and press return. The computer will print:

```
S.I.S. — INTERACTIVE STUDYING
WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
ENTER A ZERO TO QUIT
```

STEP EIGHT: Type in the identifying number of the objective you want to study, and press return (NOTE: Typing in a "0" at this point will return you to the menu described in step five). The computer will select a question from that objective at random and display it on the CRT or printer. Immediately after printing the question, the computer will print:

```
WHICH DO YOU THINK IS RIGHT?
```

STEP NINE: Type in the number (1, 2, 3, or 4) that corresponds to the answer choice you think is correct, and press return. If your answer is right, the computer will print a congratulatory statement selected at random. (Some of these will include your name.)

If your answer is wrong, the computer will print:
I THINK YOU ARE MISTAKEN, HERE, TRY AGAIN. You have one more attempt to answer the question. If your second answer choice is correct, you will then receive the congratulatory statement. If your second answer choice is wrong, the computer will print:
YOU ARE GUESSING! THE ANSWER IS (CORRECT ANSWER).
After a question is finished with, whether answered correctly or not, the computer will print:
ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE.

STEP TEN: If you want to continue studying the same objective, type in a letter "C" and press return. The computer will select another question, or, if you have read all the questions in that objective, the computer will print:

```
END OF OBJECTIVE 0000
YOU GOT 00 RIGHT OUT OF 00
(ADDS A CONGRATULATORY STATEMENT)
WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
Enter a zero to quit
```

* * * * * * * * * * *

If you want to read the explanation for that objective, type in a letter "E" and press return. The computer will print out the explanatory paragraph for the objective you are studying.

* * * * * * * * * * *

If you want to go on to another objective, type in a letter "Q" and press return. The computer will print:

```
YOU GOT 00 RIGHT OUT OF 00
(CONGRATULATORY STATEMENT)
WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
Enter a zero to quit
```

* * * * * * * * * * *

You may continue studying the objectives as long as you like. It is faster and more efficient to select objectives in numerical order. When you are finished studying the objectives, enter a zero and press return. This returns you to the menu described in step five; you can then check your test scores or cancel the program.

INSTRUCTIONS PART "B"
REVIEWING TEST SCORES

STEP SEVEN: To review your test scores for a class, type in a numeral 2 and press return. The computer will print:
ENTER YOUR COURSE NAME (EX: TAM100)

STEP EIGHT: Type in the course designation of the class for which you want to check your grades. Do not space between the letters and the numbers. Press return. The computer will print:
ID 000 (Your ID number)

The computer will then list all the non-zero scores you have in that class. These scores are identified by slot number. If you are in section one, the slot number is the same as the test number it represents. If you are in section two, add 35 to the slot number to determine the test number; in section three, add 70 to the slot number to determine the test number. The computer will then print:
YOUR AVERAGE SCORE OF ALL NON-ZERO SCORES IS 000.00.

Next, the computer will return to the menu described in step five.

When you're tired of running the computer and want to go home, type in a numeral 3 and press return. This automatically disconnects you from the computer. Don't forget to turn the terminal off!

Figure 10

EXAMPLE OF INTEST USAGE

```
*MUSIC @ VINCENNES UNIVERSITY E GENERATOR HOUSING
/ID T001TAM
*PASSWORD?

*CODE LAST USED 12:58 10OCT83
*SIGN ON  MON OCT 10, 1983  TIME=13:12  PORT=02A  RESTART=024

                 Welcome to VM/MUSIC V5.2 on IBM 4331
       Vincennes University Management Information Center

                    Users:  HELP VU.UTIL  HELP SIGNON

AVIATION STUDENT AID PROGRAMS

HELLO, WHAT IS YOUR NAME?
MIKE
PLEASE ENTER YOUR STUDENT ID:
190

ENTER 1:  TO STUDY OBJECTIVES
      2:  TO LOOK AT GRADES
      3:  TO END SESSION

CHOICE?
1
S.I.S — INTERACTIVE STUDYING

WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
ENTER A ZERO TO QUIT
2280
THE CONTINUITY OF A GENERATOR FIELD COIL IS USUALLY CHECKED WITH:
1.  AN AMMETER
2.  A FREQUENCY METER
3.  AN OHMMETER
4.  A WATTMETER
WHICH DO YOU THINK IS RIGHT?
3
FANTASTIC MIKE!  YOU ARE RIGHT!

ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE
C
WHEN USING AN OHMMETER, TO CHECK THE CONTINUITY OF A GENERATOR FIELD
COIL, THE COIL SHOULD:
1.  BE REMOVED FROM THE GENERATOR HOUSING
2.  SHOW  HIGH RESISTANCE WHEN THE METER PROBES ARE CONNECTED TO  THE
    TERMINALS OF THE COIL
3.  BE HEATED TO OPERATING TEMPERATURE
4.  SHOW VERY LOW RESISTANCE IF IT IS A SERIES FIELD COIL
```

```
WHICH DO YOU THINK IS RIGHT?
1
I THINK YOU ARE MISTAKEN HERE, TRY AGAIN
2
YOU ARE GUESSING!  THE ANSWER IS 4

ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE
E
A SERIES FIELD COIL SHOULD SHOW A VERY LOW RESISTANCE WHEN IT IS
CHECKED FOR CONTINUITY USING AN OHMMETER.

ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE
C
END OF OBJECTIVE NUMBER 2280

YOU GOT  1 RIGHT OUT OF 2

WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
ENTER A ZERO TO QUIT
2282
WHERE WOULD YOU OBTAIN PROPER INFORMATION TO OVERHAUL ELECTRICAL
EQUIPMENT ON AN AIRCRAFT?
1. FAR-43
2. THE AIRCRAFT MANUFACTURER OR THE MANUFACTURER OF THE EQUIPMENT
3. SAE ELECTRICIANS MANUAL
4. AIRCRAFT SPECIFICATIONS
WHICH DO YOU THINK IS RIGHT?
2
MIKE, THAT IS CORRECT.

ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE
C
MAJOR  ADJUSTMENTS ON EQUIPMENT SUCH AS  REGULATORS,  CONTACTORS,  AND
INVERTERS ARE BEST ACCOMPLISHED OUTSIDE THE AIRPLANE ON TEST
BENCHES WITH NECESSARY INSTRUMENTS AND EQUIPMENT.  ADJUSTMENT
PROCEDURES SHOULD BE PERFORMED AS OUTLINED BY:
1.  THE FEDERAL AVIATION ADMINISTRATION
2.  AIRCRAFT TECHNICAL ORDERS
3.  THE EQUIPMENT MANUFACTURER
4.  TEXTBOOKS
(7-P-171)
WHICH DO YOU THINK IS RIGHT?
3
HOLY MOLY! MIKE, I THOUGHT THAT ONE WOULD TRICK YOU, BUT IT DIDN'T.

ENTER E - FOR EXPLANATION, Q - TO QUIT, C - TO CONTINUE
Q
YOU GOT 2 RIGHT OUT OF 2
THAT IS TERRIFIC, YOU SHOULD GET AN A PLUS

WHICH OBJECTIVE WOULD YOU LIKE TO STUDY?
ENTER A ZERO TO QUIT
0
```

```
AVIATION STUDENT AID PROGRAMS

ENTER 1:  TO STUDY OBJECTIVES
      2:  TO LOOK AT GRADES
      3:  TO END SESSION

CHOICE?
2
ENTER YOUR COURSE NAME (EX:  TAM100):
TAM 100



ID 190
SLOT    GRADE      SLOT GRADE    SLOT  GRADE     SLOT  GRADE
-------------      ----------    -----------     -----------
501      16        502   26      503    12       504    58
505      12        506   47

YOUR AVERAGE SCORE IS 94.8%

AVIATION STUDENT AID PROGRAMS

ENTER 1:  TO STUDY OBJECTIVES
      2:  TO LOOK AT GRADES
      3.  TO END SESSION

CHOICE?
3
*GOOD-BYE. CONNECT = 00:05, S.U. = 12
```

Figure 11

SAMPLE OF INTEST STUDENT LOG

ID	NUMBER OF OBJ STUDIED	LOWEST OBJECTIVE	HIGHEST OBJECTIVE	TOTAL TIME(H)	TOTAL RIGHT	TOTAL POSSIBLE
1	9	2	1800	0.37	32	41
3	1	3	3	0.0	0	2
13	5	2	14	0.18	10	16
16	14	2138	2150	1.03	98	117
38	13	2153	2198	0.85	64	76
45	20	2153	2201	1.15	85	110
48	6	2088	2162	0.37	17	25
52	1	2332	2332	0.03	2	2
54	1	2354	2354	0.03	2	3
86	17	419	1448	0.48	26	40
97	24	2010	2432	1.88	167	190
100	19	2104	2434	1.63	94	121
102	10	2138	2150	1.17	72	85
104	16	11	2150	1.55	141	159
106	12	41	2152	0.85	53	77
124	4	23	34	0.35	19	23
202	19	1257	1600	0.75	64	68
223	1	10	10	0.02	1	3
234	4	1679	1691	0.22	17	21
280	39	238	1296	1.23	126	140
287	3	2	4	0.13	16	17
292	35	1240	1296	0.90	117	135
298	34	1240	1296	0.10	118	132
300	4	4	72	0.08	8	9
301	2	11	12	0.05	1	4
366	2	11	12	0.03	2	4
398	5	118	122	0.07	5	5

TOTAL TIME USED: 16.52 HOURS
TOTAL USERS: 27
TOTAL SESSIONS: 43

HOURLY USAGE

HOUR -	0	1	2	3	4	5	6	7	8	9	10	11
USERS -	0	0	0	0	0	0	0	0	0	0	2	5

HOUR -	12	13	14	15	16	17	18	19	20	21	22	23
USERS -	2	0	2	2	1	4	4	11	9	2	7	2

The program can be accessed on both the IBM or the Digital computers. Items can be stored according to courses. Book lists which include the references for specific questions are also listed so the student can research more information on questions which are difficult. This is especially useful if a test is returned to a student with many mistakes. The FAA test is given at the end of the two years. In order to become certified it is necessary to pass the test. It contains many of the same types of questions as the Intest Program. Documenting wrong answers and providing the resources to correct those answers helps many students focus their remediation efforts when preparing for this final exam.

The other useful feature of these programs is that a student will know which objectives present problems for them and can then use this program to review random questions which cover that particular objective.

Problems

Some students do not like using the computer. Not all instructors use it to put tests together. The use of the computer is not mandated yet for the entire school, but it is mandatory for freshmen and will be for the entire school in the 1985-86 school year.

ENHANCING A PRINTING TECHNOLOGY CURRICULUM WITH THE MICROCOMPUTER

SCHOOL: Vincennes University
ADDRESS: Printing Technology Department, Vincennes, IN 47591
TELEPHONE NUMBER: (812)885-4259
INSTRUCTIONAL PROGRAM: Printing Technology
CONTACT PERSON: Ken Whitkanack

The Printing Technology Program is a two-year Associate of Science Degree Program. Program emphasis is placed on developing technical skills in graphics arts. Graduates move into careers in all areas of Graphic Arts industries including management, service, sales and production positions in typesetting, film assembly, camera and press. Successful completion also allows students to transfer to various four-year institutions. There are approximately 70 students who major in the program at any one time and 30 students from other disciplines who take selected courses. The two-year program follows:

PRINTING TECHNOLOGY - Two Year Program Leading to A.S. Degree

	First Year	Sem I	Sem II
TPR 105	Survey of Printing Techniques	2	
TPR 107	Art and Copy Assembly	3	
TPR 110	Black and White Film Assembly	2	
BOS 100	Typewriting I -or- Elective	2	
HEW 101	English Composition I	3	
	Mathematics Elective	3	
	Physical Education Activity	1	
TPR 150	Presswork I		3
TPR 155	Typesetting I		3
TPR 160	Color Film Assembly		2
TPR 165	Reproduction Photography		3
HEW 108	Technical Writing		3
HSS 140	Introduction to Speech		2
		16	16

	Second Year	Sem I	Sem II
*TPR 200	Job Planning and Printing Estimating. .	3	
TPR 205	Reproduction Photography II	3	
TPR 210	Presswork II	3	
TPR 215	Typesetting II	3	
	Physical Education Activity	1	
	Social Science Elective	3	
TPR 240	Web Press Operations -or-		
*TPR 250	Order Entry & Production Control . . .		3
TPR 260	Printing Production Practices		
TPR 261	Cooperative Work Experience		5
	Laboratory Science Elective		3
	Social Science Elective		3
	Elective		3
		16	17

If a student's typing proficiency warrants waiver of the typing course requirement, the student will elect a two- or three-hour course.

Suggested Electives:

TPR 101	Introduction to Still Photography
TPR 202	Advanced Still Photography
TPR 220	Typesetting Interfacing Applications

*The courses describes in this profile.

(NOTE: Both of the courses which have extensively integrated the microcomputer into the curriculum are second year mid-management classes.)

History

In 1980, it became obvious that more and more jobs in the printing industry were requiring data entry or interaction with a computer terminal. This meant that graduates of the Printing Technology Department had to be provided with adequate training in computer usage paralleling its use in the printing industry.

At the same time, student evaluations of two required classes, "Job Planning and Printing Estimating," and "Order Entry and Production Control," were very poor. Evaluations included comments such as "boring," "hard to relate to the real world," and "I hate math."

As a result of these two phenomena, the instructor initiated a search for a computer-based strategy for teaching the course content. He wrote a grant for software development, specifically for these two courses, and was funded by the University.

As a first step, a consultant was brought in who had both extensive experience in the printing industry and had written custom software for an instructional setting. The consultant met with students, faculty members and advisory committee members, thus making a thorough study/evaluation of the curriculum. He made the following recommendations:

- Because of the presence of and positive reaction to home video games, classes should take on a new meaning with the use of microcomputers.
- Develop customized software so that students can use microcomputers as an instructional tool.
- Develop the curriculum so that tedious calculation problems could be completed by the computers, thus making the course more interesting.

The recommendations were accepted by the faculty. An outside vendor was hired, who had developed software for commercial printing establishments, assuring the faculty that the training received was comparable to that used by the industry. (The vendor was Don Goldman in Marblehead, Massachusetts.)

Microcomputers were then purchased and after several modifications of the software and the documentation, the project was approved. The committee decided to buy four Apple IIe's and a printer. There are currently four microcomputers in the printing classroom; others are available in the Learning Resource Center.

The instructors were trained by the local microcomputer dealer through an on-campus inservice. The software developer also put in extensive time setting up the system. He provided all the information needed to run the system, including a formal manual for all users. He also conducted 1:1 orientations with the students and group sessions with anyone who was interested in using the hardware and/or software.

Integrating The Microcomputers Into The Curriculum

The computers are formally being used in two courses: Job Planning and Printing Estimating (TPR 200), a required course for all those in the Printing Technology Department, and Order Entry and Production Control (TPR 250), an advanced course in the same department.

- TPR 200 Job Planning and Printing Estimating 3 hours (Sem. I)

  Prerequisite: TPR 155, Provides instruction in job planning; paper selection; layout imposition; operation; equipment selection; computation of production hours for all printing functions; and other pertinent considerations leading to estimating printing costs. The use of a computer as both an educational aid and tool used for job planning/estimating will be emphasized. Course consists of 3 hours lecture plus 2 hours arranged lab per week.

- TPR 250 Order Entry and Production Control 3 hours (Sem. II)

  Prerequisite: TPR 200, Provides instruction and experience in order and production control techniques. Includes: job jacket preparation; inventory management; job costing; production reporting; plus related areas including how to read and make effective use of reports. Use of a computer for job cost and production cost function will be emphasized. 3 hours lecture plus 2 hours laboratory.

These two courses which have formally integrated the microcomputers are using them at the management level. The microcomputers are being used to prepare production reports, as well as estimates. These reports include departmental and material costs and allow for multiple quantity changes immediately. The reports utilize cost figures for production and, in so doing, illustrate differences to the consumer between production methods, time and price. The computers are also being used to generate the text for reproduction, although not extensively.

According to Whitkanack, one common problem which faces the students in Estimating and Job Planning is completing calculations to determine budgets. To train a student how to use the computer to eliminate the difficulties inherent in such a task, the following problem would be presented to the class. "A customer wants 5,000 booklets printed and in the estimate wants the prices of different quantities, using different designs and paper weight." (These projects are assigned during a lecture period and completed either with the microcomputers in class or on machines located around the campus.) A printer must give quick and accurate estimates in order to stay in business. The computer system used in the Printing Technology Department has been designed to facilitate problem-solving of this sort.

Other projects completed with the microcomputer might include the presentation of an initial idea, when a vague presentation is made by the customer. The printer must develop and produce several workable forms (with prices) for the customer in a limited period of time. Previously it would take three to four days just to compute the calculations. If the microcomputer does the calculating, approximately one-third of the time is eliminated from the planning tasks. These are exactly the kinds of tasks, within industry, which are being completed with the microcomputer on the management level.

The microcomputers are also being used to meet the computer literacy needs of students. The department offers training in

Visicalc and has written programs in BASIC for students in the major. Eventually, the microcomputers will also be used in typesetting. The department is currently relying on computers designed solely for typesetting to generate the text for reproduction.

Evaluation

There has not been a formal evaluation of the role of the microcomputer in these two courses. Informally, the staff agrees that the microcomputer does motivate students. The use of the microcomputer has resulted in a great amount of enthusiasm displayed by both instructors and students, resulting in better teaching. Initially the students played video games as a way to initiate them to the keyboard. They then moved to formal, course-related project assignments. That appears to have been a positive way to introduce the technology to the computer novice.

One problem has been encountered regarding the grading and evaluation of projects that are completed with the microcomputer. There is no way to document the process used by the students which led up to the final documents submitted for a grade. The instructor only sees the end result and it is not possible to tell how much time the student spent on it, nor if it was authored by them.

The software does not include a classroom management component. That is an element that will be included in the future.

Contacts with industry have led the faculty to believe that they are on the right track in their planning. The printing industry is beginning to use the microcomputer although many companies still use a large mainframe computer. The software that was developed for this course is capable of both teaching microcomputer-related skills and simulating what happens on a mainframe. The processes are the same; the difference is in the amount of data that the computer can hold in memory.

In conclusion, the instructor of these printing technology courses has found that using microcomputers in these "boring" courses has brought new life into teaching and learning.

USING THE MICROCOMPUTER TO MANAGE IN A SECONDARY LEVEL T & I PROGRAM

SCHOOL: Saunders High School
ADDRESS: 183 Palmer Road Yonkers, New York 10701
TELEPHONE NUMBER: (914)963-4567
INSTRUCTIONAL PROGRAM: Mechanical Technology Program
CONTACT PERSON: Michael R. Richardson

Mechanical Technology is the study of many independent technical areas. The program at Saunders High School stresses mechanical drafting, strength of materials, machine shop, design theory, and materials testing. In addition, students are introduced to hydraulics, pneumatics, fluidics, precision measurements, logic circuits, digital computers, statistics, analog computers, and several other areas that fall under the broad umbrella of Mechanical Technology.

Mechanical Technology students at Saunders also carry a traditional academic program so that they are prepared for admission to engineering schools for advanced study. The list of courses follows:

Grade	Subject	Period(s)
10	English	1
	Geometry	1
	Gym	1
	Language	1
	Drafting/Health	1
	Drafting	1
	Machine Shop	2

Grade	Subject	Period(s)
11	English	1
	Trigonometry	1
	Gym/Physics Lab	1
	History	1
	Physics Theory	1
	Computer Problem Solving	1
	Drafting	2
12	English	1
	Gym	1
	History	1
	Machine Shop/Electiv	1
	Mechanical Design Theory	1
	Testing Lab Theory	2
	Elective	1

Background

The microcomputer has been extensively integrated into the Mechanical Technology Program at Saunders High School. The computer was originally integrated into the Mechanical Technology curriculum to give programming experience to students so they would not be at a disadvantage once they entered college. It was also felt that the curriculum would be more attractive to those who were deciding which course of study to pursue.

Hardware available to the Mechanical Technology Program includes 12 TRS-80 Model II's in an open lab. Each microcomputer has 64K and an 8-bit microprocessor so that they are usable by all disciplines. The school has an additional 24 computers in a separate lab, used by 10th and 11th graders. Every student gets at least one-half year of exposure to the computers. Students frequently utilize the computers for word processing using Scripsit, a program developed by Radio Shack. All materials used in the lab were either purchased from Radio Shack or developed by the instructor.

Inservice Training

Training for the instructors has generally not been supported by the administration. Integrating the microcomputer into the curriculum is the responsibility of individual teachers. Originally, training was not available because no one in the school system had any knowledge of computers at the time they were introduced into the Mechanical Technology Program. The current instructor took on the responsibility for reading the manuals, introducing various computer-oriented topics into the established curriculum, and finally starting to teach a course about the computer itself after completing independent, self-supported work with the computer. Currently, instructors are receiving inservice training and take time during the summer to take programming courses at local colleges, although there is no financial support to do so.

Use Of The Microcomputer In The Classroom

In general, the instructor avoids using the computer as an instructional tool. Instead, he reserves its use for the generation of instructional materials and the management of instruction (See Figure 1). In the few situations where he has prepared materials for instruction, he has taught the material before the students have access to the computers for drill and practice of the concepts. For example, he has used drill and practice to enhance the teaching of mathematical approximations regarding the manipulation of numbers. He has also written some drill-and-practice programs focusing on multiplication and addition for the remedial math students.

Figure 1

MANAGING DRILL AND PRACTICE

```
TOTAL ANSWERS            Completed 20          Correct = 20    Last Ans = 20
GIVEN ...   22             To Go  0            Incorrect  2

     GRADE = 90% for problems or 90.9% for total answers given

Starting time was 03.22.15
Finishing time is 03.22.54
Seconds = 39    Seconds/problem = 1.95

      11    7    3    8    9   12    2    5    1    4   10    6
  9    :    .    .    :    .    .    .    .    .    .    .    .      9
  3    :    .    .    .    *    :    .    .    .    .    :    .      3
  1    .    .    .    .    .    .    .    .    .    .    :    .      1
 10    .    .    .    .    :    .    .    .    .    .    .    .     10
  2    .    .    .    .    .    .    .    :    .    :    .    .      2     MULTIPLICATION
  4    .    .    .    .    .    .    .    *    .    .    .    .      4
  5    .    .    .    .    .    .    .    .    .    .    .    .      5        PRACTICE
 12    .    .    .    :    :    .    .    .    .    .    :    .     12
  7    .    .    .    .    .    .    .    .    .    .    :    .      7
  6    .    .    .    .    .    .    .    .    .    .    :    .      6
 11    .    .    :    .    .    .    .    .    .    .    :    :     11
  8    .    .    .    .    .    .    .    .    .    .    .    :      8
      11    7    3    8    9   12    2    5    1    4   10    6
```

```
                       Completed 20          Correct = 20          Last Ans = 20
TOTAL ANSWERS            To Go  0            Incorrect  2
GIVEN ...   22


     GRADE = 90% for problems or 90.9% for total answers given

Starting time was 03.22.15
Finishing time is 03.22.54
Seconds = 39    Seconds/problem = 1.95

      11    7    3    8    9   12    2    5    1    4   10    6
  9    :    .    .    :    .    .    .    .    .    .    .    .      9
  3    :    .    .    .    *    :    .    .    .    .    :    .      3
  1    .    .    .    .    .    .    .    .    .    .    :    .      1
 10    .    .    .    .    :    .    .    .    .    .    .    .     10
  2    .    .    .    .    .    .    .    :    .    :    .    .      2     MULTIPLICATION
  4    .    .    .    .    .    .    .    *    .    .    .    .      4
  5    .    .    .    .    .    .    .    .    .    .    .    .      5        PRACTICE
 12    .    .    .    :    :    .    .    .    .    .    :    .     12
  7    .    .    .    .    .    .    .    .    .    .    :    .      7
  6    .    .    .    .    .    .    .    .    .    .    :    .      6
 11    .    .    :    .    .    .    .    .    .    .    :    :     11
  8    .    .    .    .    .    .    .    .    .    .    .    :      8
      11    7    3    8    9   12    2    5    1    4   10    6
```

In general, the instructor has used the microcomputer to make his teaching more efficient and effective. Following are examples of his uses of the microcomputer. To summarize the use of the microcomputer, it is used to "process data." That includes data from an experiment, homework assignments, grades, test items, lab reports, and performance reports.

Figure 2

ANALYSIS OF TEST RESULTS

	Student	RT	WG	Percent
EEBDCCBBADBBDDAABECF	301	16	4	80
AETBCCCCACBCFBBAEFEB	302	7	13	35
EEBDCCBBADBBDFAABECF	303	17	3	85
EEBDCCFEADBBEFBECFDF	306	11	9	55
EEBDCCDFADBBDDEABBDF	307	15	5	75
EEBDCCBBADBBEFEABBCF	308	18	2	90
ACFCBCBBAABBDFAACBDF	310	11	9	55
AEBDCCBBADBBEFEABBCF	311	17	3	85
EEBDCCBBCDBBEFEEBEDA	312	13	7	65
EABDCCFFADDBEFEEEEEB	313	9	11	45
EEBECCBBADBBDFEABBEB	315	18	2	90
AEBEFCBFADBBEFAAEFDF	316	12	8	60
EEBDBCBBADBBEFEABBCF	317	17	3	85
AEBDCCBBADBBEFEABBCF	318	17	3	85
EEFDCCBBADBBDFBABBCF	320	17	3	85
EEBECCBBADBEDFEABBCF	321	19	1	95
EEBECCDBADBBDFBABBEF	322	17	3	85
EEBECBBEADBBFFBEBFCF	323	14	6	70
EEDECCFBADBBFFEACFDA	324	13	7	65
EEBFCCBBADBEDFEABBCF	325	19	1	95

Average grade = 74.25 = 74

NUM	A	B	C	D	E	F	T	Above average students with it wrong	Below average students with it wrong
1	-5	0	0	0	15	0	0	2	3
2	-1	0	-1	0	18	0	0	0	2
3	0	16	0	-1	0	-2	1	1	3
4	0	-1	-1	-11	7	0	0	8	5*
5	0	-2	17	0	0	-1	0	1	2
6	0	-1	19	0	0	0	0	0	1
7	0	14	-1	-2	0	-3	0	2	4
8	0	14	-1	0	-2	-3	0	1	5
9	19	0	-1	0	0	0	0	0	1
10	-1	0	-1	18	0	0	0	0	2
11	0	19	0	-1	0	0	0	0	1
12	0	17	-1	0	-2	0	0	2	1*
13	0	0	0	9	-8	-3	0	4	7
14	0	-1	0	-2	0	17	0	2	1*
15	-4	-5	0	0	11	0	0	4	5
16	16	0	0	0	-4	0	0	0	4
17	0	14	-3	0	-3	0	0	0	6
18	0	11	0	0	-4	-5	0	2	7
19	0	0	10	-6	-4	0	0	3	7
20	-2	-2	0	0	0	16	0	1	3

Figure 3

ANALYSIS OF TEST RESULTS

NAME . . . .   NUMBER . . . .

THIRD MK PD

```
81    92    94    50    82    83    86    63    95    86    91    71    78
73    73    88    96    86
```

	NUMBER	AVERAGE	STANDARD DEVIATION
Students Taking Test	18	81.6	12.0
Passing Students	16	84.7	8.0
Failing Students	2	56.5	9.2

To the student ...
Circle your grade above and the star that represents it below.

To the parent ...
Please sign next to the circled star so I know that you know.

```
                                                   *
                                                   *
                                                   *     *
                                             *     *     *
                                             *     *     *
                                             *     *     *
                                 *     *     *     *     *

!-----!-----!-----!-----!-----!-----!-----!-----!-----!-----!
  1s    10s   20s   30s   40s   50s   60s   70s   80s   90+
```

Figure 4

SCHOOL HONOR ROLL REPORT

Saunders High Honor Roll - 3rd marking period 1983-1984

Andrade	Manuel	ARCH	11	95.83
Bailey	Raymond	GRO6	9	93.80
Cianfaglione	John	MECH	11	94.33
Commisso	Anthony	EWIR	10	92.40
Darcy	Patricia	CHEM	10	94.40
Egan	Craig	TELC	12	95.00
Evanko	John	GRO2	9	95.00
Goldberg	Melinda	CHEM	11	95.42
Hurwitz	Glen	GRO2	9	97.00
Kinsella	Richard	CHEM	12	92.80
Laverde	Linda	GRO3	9	93.80
Lin	Raymond	CHEM	10	93.33
Maffei	Michele	GRO3	9	96.80
Mancini	Robert	EWIR	12	92.60
Oricchio	Janice	CHEM	10	92.40
Pollack	Carl	GR11	9	92.50
Rabadi	Steven	GRO6	9	93.80
Rados	Stella	GRO3	9	93.60
Reinah	Linda	GRO6	9	93.00
Rodriguez	Carlos	GRO4	9	94.50
Stefano	Ann Marie	GRO2	9	95.00
Vallecca	James	GRO6	9	94.80
Vernile	Laura	GR11	9	96.50
Walsh	Christie	CHEM	11	92.14
Walsh	Martine	GRO2	9	95.00

Saunders High Honor Roll - 3rd Marking Period 1983-1984

Hurwitz	G.	GRO2	9	97.00
Maffei	M.	GRO3	9	96.80
Vernile	L.	GR11	9	96.50
Andrade	M.	ARCH	11	95.83
Goldberg	M.	CHEM	11	95.42
Egan	C.	TELC	12	95.00
Evanko	J.	GRO2	9	95.00
Stefano	A.	GRO2	9	95.00
Walsh	M.	GRO2	9	95.00
Vallecca	J.	GRO6	9	94.80
Rodriguez	C.	GRO4	9	94.50
Darcy	P.	CHEM	10	94.40
Cianfaglione	J.	MECH	11	94.33
Bailey	R.	GRO6	9	93.80
Rabadi	S.	GRO6	9	93.80
Laverde	L.	GRO3	9	93.80
Rados	S.	GRO3	9	93.60
Lin	R.	CHEM	10	93.33
Reinah	L.	GRO6	9	93.00
Kinsella	R.	CHEM	12	92.80
Mancini	R.	EWIR	12	92.60

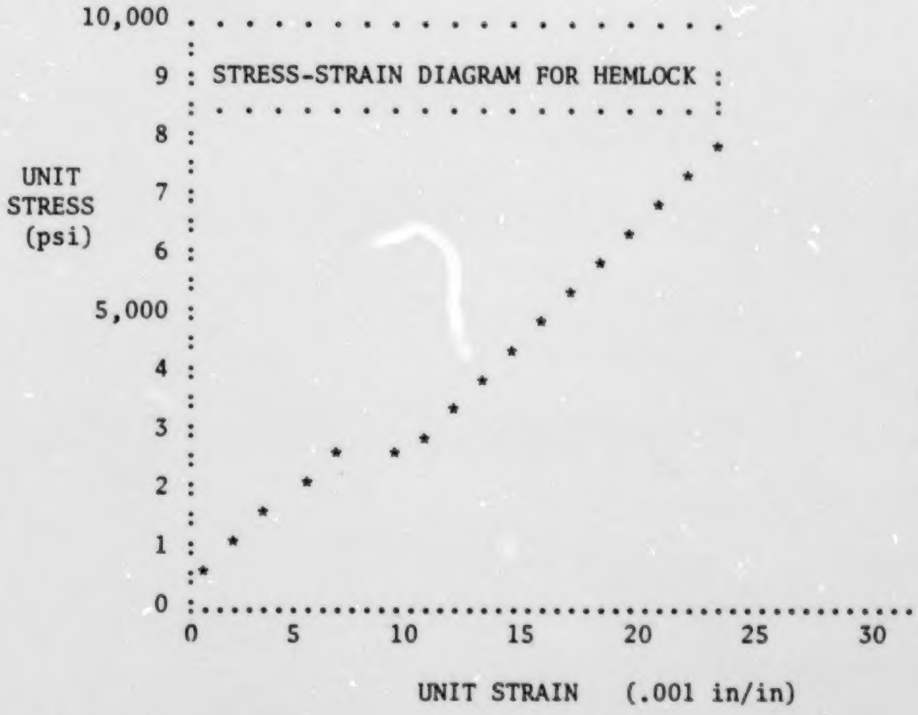
During experiments, students' raw data is entered into the computer and analyzed. Students have access to the computer to process their data if they are willing to write a program. Some students use it and others do not. The teacher takes advantage of the computer's capabilities during experiments by giving every student a different database while still having the time and skills to adequately supervise the work. Results from the experiment can then be checked out on an individual basis because the computer can quickly complete the routine checks of student work.

This leads to the most unique feature of the computer in the Mechanical Technology Program. That is, the ability of the computer to solve many versions of the same "class" of problems quickly and correctly. In that capacity, it can be used to generate individual homework assignments, grade lab reports, draw graphs from students' generated data, store student answers for later editing while parts of an experiment are being reworked, and score test items for test generation (See Figure 5).

The computer is also being used to analyze answers to determine where the students have misconceptions or a lack of critical knowledge. A written document then explains those weaknesses. The instructor has written several programs which will generate individualized homework assignments and answer keys used to grade the work (See Figure 6).

Figure 5

GRAPHS FROM STUDENT GENERATED DATA



Catrina Bryant

7,310	.0027
6,850	.0025
6,390	.0023
5,940	.0021
5,480	.0019
5,020	.0017
4,570	.0015
4,110	.0013
3,650	.0012
3,200	.0010
2,740	.0009
1,830	.0005
1,370	.0003
910	.0002
460	.0000

```
Calc E = 3,445,540 psi
Best E = 2,569,370 psi


A = 2.190
L = 6.188
Number  N = 16
Sigma   X =.020655
Sigma  X*X=.000037
Sigma   Y = 62,110
Sigma  X*Y=    108
```

(Figure 5 cont'd on next page)

Figure 5 cont'd.

```
L O A D = 2000 g
STUDENT NUMBER ? 1
Angle B = 63.44   Hor 1   Ver 2   Hyp 2.24     Sin .894   Cos .447   Tan 2
Angle B or 0 ? 0
Sloping Force F = -1118.03
Horiz Force S = 500

Angle A or 0 = ? 0
Sloping Force T = 1118.03
Horiz Force D = -1000

Inside Angle C = 48.81  _____                           D
Sloping Force G = 0                 . . . . . . . . . . . . . . .
Mid Horiz Force H = 1000           . .           . .         A . .
                          40      .   .         .   .         .   .
LAYOUT DISTANCES                 .     .       .     .G     T.     .
 20 + 20 + 35 = 75              .       .     .       .     .       .F
                               .         .   .         .   .         .
                              .           . .           C . .         B .
                        _____. . . . . . . . . . . . . . . . . . . . . .
                                                     H           S

                              <------------------- 150 ---------------->


L O A D = 2000 g
STUDENT NUMBER ? 2
Angle B = 56.31   Hor 2   Ver 3   Hyp 3.61     Sin .832   Cos .555   Tan 1.5
Angle B or 0 ? 0
Sloping Force F = -1201.85
Horiz Force S = 666.667

Angle A or 0 = ? 0
Sloping Force T = 1201.85
Horiz Force D = -1333.33

Inside Angle C = 61.56  _____                           D
Sloping Force G = 0                 . . . . . . . . . . . . . . .
Mid Horiz Force H = 1333           . .           . .         A . .
                          40      .   .         .   .         .   .
LAYOUT DISTANCES                 .     .       .     .G     T.     .
 26.7 + 26.7 + 21.7 = 75        .       .     .       .     .       .F
                               .         .   .         .   .         .
                              .           . .           C . .         B .
                        _____. . . . . . . . . . . . . . . . . . . . . .
                                                     H           S

                             <-------------------- 150 ----------------->
```

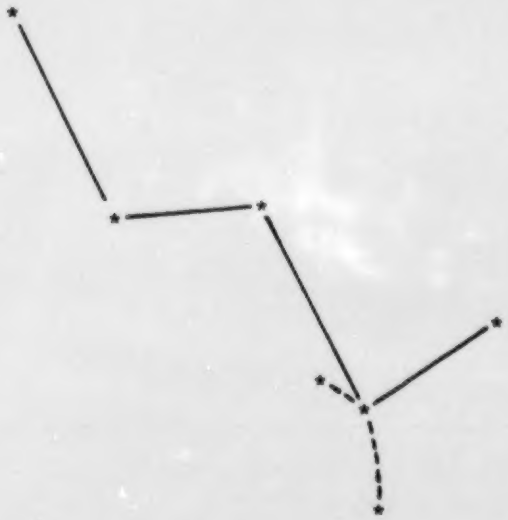
Figure 6

INDIVIDUALIZED HOMEWORK ASSIGNMENTS

```
(1)

255 N @ 13 deg.      +  405 N @ 135 deg.     +   1416 N @  226 deg.  =


Sigma Fx = ?

255 * COS( 13 )      +  405 * COS( 135 )     +   1416 * COS( 226 )   =
255 * COS( 13 )      -  405 * COS(  45 )     -   1416 * COS(  46 )   =
255 * ( .97437 )     +  405 * (-.707107 )    +   1416 * (-.694659 )  =
( 248.464 )          +  (-286.378 )          +   (-983.637 )         = -1021.55 N


Sigma Fy = ?

255 * SIN( 13 )      +  405 * SIN( 135 )     +   1416 * SIN( 226 )   =
255 * SIN( 13 )      +  405 * SIN(  45 )     -   1416 * SIN(  46 )   =
255 * ( .224951 )    +  405 * ( .707107 )    +   1416 * (-.71934 )   =
( 57.3625 )          +  ( 286.378 )          +   (-1018.59 )         = -674.844 N

Ref Angle = 33.4491 Degrees                           Tangent = .660608

RESULTANT = 1224.33 NEWTONS at 213.449 degrees




(2)

113 N @ 36 deg.      +  183 N @ 171 deg.     +   1647 N @   277 deg. =

Sigma Fx = ?

113 * COS( 36 )      +  183 * COS( 171 )     +   1647 * COS( 277 )   =
113 * COS( 36 )      -  183 * COS(  9  )     +   1647 * COS(  83 )   =
113 * ( .809017 )    +  183 * (-.987688 )    +   1647 + ( .121869 )  =
( 91.4189 )          +  (-180.747 )          +   ( 200.719 )         =  111.391 N

Sigma Fy = ?

113 * SIN( 36 )      +  183 * SIN( 171 )     +   1647 * SIN( 277 )   =
113 * SIN( 36 )      +  183 * SIN(  9  )     -   1647 * SIN(  83 )   =
113 * ( .587785 )    +  183 * ( .156435 )    +   1647 * (-.992546 )  =
( 66.4197 )          +  ( 28.6275 )          +   (-1634.72)          = -1539.68 N

Ref Angle = 85.862 Degrees                            Tangent  = 13.8223

RESULTANT = 1543.7 NEWTONS at 274.138 degrees
```

Figure 6 cont'd.

Cassiopeia



Cassiopeia

```
REFERENCE POSITION =   1 hours    0 minutes
                   =  60 degrees  0 minutes

Star
Epsilon
  1 hours     51 minutes
 63 degrees   28 minutes
X = -1.80
Y =  1.09

Star
Gamma
  0 hours     54 minutes
 60 degrees   27 minutes
X = 0.23
Y = 0.14

Star
Delta
  1 hours     23 minutes
 60 degrees    0 minutes
X = -0.90
Y =  0.00

Star
Beta
  0 hours      6 minutes
 58 degrees   51 minutes
X = 2.21
Y =-0.36
```

Within that program, , a procedure is embedded that cycles the assignment back and forth to the students so that the weaker students work on it over a period of a week or two. The better students are expected to complete the assignment in a shorter period of time and move onto to a higher level of difficulty.

In addition, grades and weighted averages are calculated and reported by the computer.

Figure 7

WEIGHTED AVERAGES

BASIC COMPUTER PROBLEM SOLVING

	TEST 811	TEST 812	HW - 811	VECT QUIZ	US - 6	HW - 812	PROGRAM		
Weights...	5	5	4	2	1	4	5	Avg	Grade
1 Aponte	40	47	62	70	0	40	66	51	53
2 Barreto	15	72	40	70	70	70	90	59	70
3 Bellizzi	60	47	68	90	70	76	82	68	73
4 Bucciero	58	65	88	100	50	90	98	80	85
5 Cheron	55	57	80	90	60	80	44	64	69
6 Gorman	73	77	92	90	70	88	58	77	82
7 Kohl	40	67	70	80	80	96	46	64	70
8 Letona	50	52	60	90	0	18	88	55	62
9 Luster	73	93	98	70	100	86	82	85	88
10 Maslowski	35	70	64	90	90	94	93	73	82
11 McMurrough	58	45	70	70	60	50	63	58	61
12 Mulvaney	60	77	72	55	80	68	92	73	76
13 Olson	43	43	50	55	0	42	94	53	55
14 Pici	55	67	78	80	100	90	87	76	81
15 Radwan	75	70	104	100	100	96	81	86	90
16 Radwan	68	80	98	100	100	92	81	85	89
17 Rhodes	25	10	88	70	80	96	91	61	73
18 Velasquez	70	73	72	100	90	98	92	83	85
19 Villani	73	72	86	70	80	80	89	79	81
20 Wood	53	68	48	80	80	72	89	68	72
21 Yedowitz	23	50	74	80	0	72	77	57	66
22 ^ Crawford	AA	AA	0	50	0	18	0	7	8

Performance reports are generated with the data entered during assignments and tests; standard messages can be sent to parents and administrators.

The computer is also used by the instructor as a word processor. He uses it everyday for the preparation of information sheets, letters and related course materials. It enables the teacher to quickly prepare materials and to store test items and information sheets on disk files.

According to this instructor, in order to use the computer to manage instruction as he has done, the instructor needs to be able to program to make use of the technology and to adequately customize the software to fit the needs of a particular curriculum.

Evaluating The Impact Of The Microcomputer

The computer has not changed the student-teacher relationship. It should be remembered, however, that in this situation the computer is used more as a tool by the teacher than as a tool for teaching the students.

Student-student relationships have changed somewhat. In the programming class, students often ask each other for help. Because the machine is so new to everyone and because so many people are just learning the fundamentals, it is not uncommon to see students helping each other. They are encouraged to work in pairs while doing class work so that they can share their ideas.

The role of the microcomputer has not been evaluated as a tool for instruction. The district has just started introducing microcomputers in the elementary and middle schools so an evaluation plan has not yet been developed in the district. According to this instructor, the computer never needs to be evaluated. It is like a typewriter--a tool that a good instructor should use. It is such an integral part of his job that he has not even thought about it as an object of evaluation.

The end result of integrating the microcomputer into instruction in this way is increased efficiency in teaching. It has little effect on learning or retention. It does have an effect on knowledge acquisition and skill development because it enables the instructor to give individual problems for homework and as take-home quizes. This prevents wholesale copying and forces students to do their own work.

This instructor does not like the computer as a teaching tool and is reluctant to use it as such. The computer is like a book. He would like to have students learn from it, but is afraid to put them into a situation where the computer, or the book, is their sole source of information.

The computer is the backbone for all teaching activities. According to this instructor, the average instructor cannot get maximum use from the computer because it takes too much time to learn programming. His message throughout the interview has been to advise teacher training colleges to have courses that teach the newcomers how to program computers to do instructionally-related tasks.

COMPUTER-MANAGED INSTRUCTION IN A MAJOR APPLIANCE SERVICING PROGRAM

SCHOOL: Moraine Park Technical Institute
ADDRESS: 235 N. National Avenue, Fond du Lac, WI 54935
TELEPHONE NUMBER: (414)922-8611
INSTRUCTIONAL PROGRAM: Major Appliance Servicing
CONTACT PERSON: David Sullivan

The Major Appliance Servicing Program at Moraine Park Technical Institute teaches students how to service large appliances such as washers, dryers, air conditioners, stoves and microwave ovens. It is a 45 week competency-based diploma program structured as a multiple entry program, meaning that there are two times a year (every 27 weeks) when students can enter the program. There are approximately 18-20 students in the program at one time.

In their major, students must enroll in the following courses:

First Quarter - Appliance Electricity
- Refrigerator Principles

Second Quarter - Refrigeration Service Techniques
- Schematic Wiring Diagrams

Third Quarter - Gas Controls
- Solid State Electronics

Fourth Quarter - Laundry Equipment Servicing
- Refrigeration Servicing 1 (Air Conditioners and Dehumidifiers)
- Appliance and Consumer Problems

Fifth Quarter - Kitchen Appliance Servicing
- Refrigerator Servicing II (Regrigerators, Freezers and Ice Makers)

In addition, each student must take:

- One math course
- One course in human relations
- One course in communications
- One course in service management

The instructor in this program has instituted a computer-managed laboratory for the courses taught in Major Appliance Servicing. He is using the microcomputer for grading, testing, and maintaining student records. Other uses include inventory control, job placement, and managing the records which keep track of competencies mastered by each student. A more detailed description of these applications follows.

Uses Of The Microcomputer

The Computer-Managed Laboratory uses one TRS-80 Model IV. A testing lab with approximately 20 TRS-80 Model IV's is also available to the students. Some of the software was purchased from Radio Shack and then modified to reflect the characteristics of this instructional program. Other programs were written by the instructor.

Most students do not use the computer before the fourth quarter because they are not working in the shop until that time. Before that time, the major appliance servicing instructor teaches the computer literacy portion of the program. This includes a general literacy section and knowledge about each program used in the lab. Projects are presented in the form of consumer problems.

(1) Student Records

Teacher Aid by Radio Shack was written for maintaining student records in an elementary classroom. It was revised for this competency-based program. The program PROGRESS is used to manage the instruction, i.e., the competencies to be mastered. The competency/task list is entered into the computer and the program maintains records which list the tasks completed by each student, grades received on the tasks and competencies yet to be completed.

This student report is maintained throughout the five quarters until the time at which all competencies have been met and the student receives a diploma.

(2) Inventory Control

The software Inventory Control System, written by Radio Shack, is used to manage the Equipment Repair Lab in the same manner as one would manage an appliance shop. Minor changes were made in the program which give the instructor more options, such as increasing the space so that more records can be maintained than the original program accommodated.

The software keeps track of the parts and pieces used to complete repairs. For example, if a student is repairing an appliance, the student determines the part number needed for the work and the price of that part. S/he can then go to the computer, type in the stock number of the part, and the computer will tell the student if that part is maintained in inventory, the location of the part, and the cost. The computer automatically reduces the inventory count and does the proper accounting, keeping an accurate summary of records as students use and order parts. If the part is not in stock, the program automatically moves to the requisition process so the part can be ordered. Another data file maintains a list of high usage items and the time of year that they are routinely used. The records are used for end of year summaries and reports.

(3) Records Management

The instructor uses PROFILE III (Radio Shack) as a data management system. Within the appliance servicing program, approximately 300 appliances are bought and then sold each year after being reconditioned. The computer keeps track of all the appliances in the lab, the serial number of the appliance and information from the invoice sheet. In addition, it maintains an inventory of all tools, equipment, videotapes, and films purchased for instructional purposes.

The microcomputer is also used for placement purposes. The instructor maintains a list of dealers within a 150 miles radius of the school. He also maintains a list of dealers across the country who have hired Moraine Park Appliance Servicing graduates.

(4)Future Applications

In the future, the instructor foresees the role of the computer increasing to maintain a cross reference list of appliance parts. Frequently, similar parts are used by two different companies for the same repair such as the valves from the Maytag and Singer companies. Thus, if a part is needed and not available, this list will provide students with the names of parts from other companies which can serve the same purpose, such as a start relay for an Admiral refrigerator.

Another aspect of the instructional process which has not yet been computerized is a task list of competencies and an accompanying list of equipment items and supplies needed to complete each task.

Once these applications are integrated into the instructional process, the instructor feels it might be necessary to move to the IBM because of the IBM's abilities to maintain greater quantities of data and afford access to the IBM mainframe owned by the school.

An obvious omission from this list of uses is Computer-Assisted Instruction. The instructor feels that there is insufficient CAI on the market to teach the appliance servicing curriculum. He feels that starting with CMI is a logical way to proceed in any competency-based curriculum, especially one that has a large amount of equipment and tasks to manage.

The instructor has found that, as a result of the microcomputer's role in maintaining the shop, students are taking more time to be efficient with the lab's equipment and tools. In previous years, the funds for parts and supplies were quickly spent because of student inefficiency. The computer has forced them to improve on the organization and management of their own projects. It also gives the student more control over the inventory and greater access to the stock in the repair shop.

In addition, the students are learning a skill that can be very useful whether they begin their own appliance servicing business or work for another employer. Regardless of where they work, they will need to keep their own records and manage information.

Evaluation

There are not currently enough graduates to formally evaluate the effectiveness of the microcomputer-based lab (shop) but the instructor feels that employers will react positively to the innovation. In fact, one student told his new employer about the computerized inventory system and the employer proceeded to institute the same system in his shop.

Problems

Problems which have arisen while integrating the microcomputer to manage instruction and the shop include:

- Limited time available to orient the students to the system.

- High quality software is not available. For example, the software currently being used accepts errors without informing the user that an inappropriate entry was made.
- Using the computer for CAI would be ideal but there is not sufficient software available.

Testing and interactive video are two areas worth exploring to alleviate some of these problems. Interactive video is one way to get around the lack of CAI software in this curricular area. For example, an interactive video session on refrigeration could be developed to teach "troubleshooting." It could be used to demonstrate troubleshooting of a machine, such as a refrigerator, step-by-step. It could also be used to assist a student who is trying to solve a problem. A student could enter the symptoms and the computer would diagnose the problem and serve as a resource for the students. This could be a tremendous enhancement to the instructional process and a reliable, up-to-date information resource.

USING A MICROCOMPUTER TO CONTROL A MILL

COMPANY: Refresh Your Memory
ADDRESS: 1430 Sprucewood Drive, San Jose, CA 95118
TELEPHONE NUMBER: (408)265-5449
INSTRUCTIONAL PROGRAM: Industrial Technology
CONTACT PERSON: John Hosman

This company has developed a software program which enables an instructor to use the computer to control a mill, a tool commonly part of the industrial technology curriculum in both secondary and post-secondary education. The program directly connects a numerical control machine to a mill. Previously, students had used a teletype for punching the holes that controlled the mill. That equipment is comparable to a manual typewriter with no correction key. Students would produce a punched tape, but if mistakes were made on the tape which defined the work of the mill, the students had to retype the entire tape again. This was a frustrating and difficult process for a student and resulted in time spent on a meaningless, unproductive activity. With that type of apparatus, projects were rarely completed and creative ideas were often lost in the process.

The Use Of The Microcomputer With The Mill

The microcomputer, with the accompanying software, has revolutionized the process of planning projects for the mill. With the computer, students are able to complete all the X and Y coordinates, move lines, find and replace mistakes, print, and draw the designs; all of which were impossible with the inflexible design practices used prior to the application of microcomputer technology.

With this innovation, the curriculum can be changed so that it is built around the computer, meaning that students can complete the preliminary stages of a project designs before they get near the mill. The design process utilizes the capabilities of the microcomputer. Therefore, training of both instructors and students needs to focus on utilizing and expressing those capabilities, thus enhancing the instructional process.

A set of worksheets has been developed by Refresh Your Memory for projects which focus on the skill development needed to complete the following eight steps:

1) Drawing a free hand sketch of the design.
2) Putting the sketch onto coordinate graph paper.
3) Labeling the coordinates.
4) Writing out the machine code which communicates to the computer the instructions for completing the design (this constitutes the programming to fulfill the specifications of change from the old system).
5) Typing the program into the flex writer (entering the program with a keyboard so some keyboarding skills would be helpful during this step). It is during this step that the student is able to obtain a picture of the project from the plotter before the program is entered into the mill.
6) Running the project on the mill.
7) Making corrections in the program after seeing the sample product from Step 6. (Again, this was never possible to do in the limited time that the students had to work on the mill.)
8) Going back to the mill after all the corrections are made to make the final product.

Not only does the addition of the microcomputer into the production of projects completed with the mill provide a student with the means to finish a project in a reasonable amount of time with minimal frustration, but using the computer to complete projects also solves problems of limited equipment and overscheduled use of the mill. For example, at Silver Creek High School in San Jose, the mill that is used in the industrial technology program is a "traveling mill." This means that other high schools in the district also use the mill. Silver Creek can use the mill for only nine weeks out of the year. By using the computer, the student is able to complete all the work that needs to be finished prior to working on the mill (Steps 1-5). When the mill arrives, the students can run the project, make corrections and complete the final product. With the microcomputer, it is estimated that instead of completing one project per year, the record in the past, students will be able to run 25-30 projects with a maximum of efficiency and a minimum of frustration because all design problems will be corrected prior to using the mill.

Thus, through this use, the microcomputer has served to enhance the skill development of students. The mill is still being taught. The way that it is taught, and the steps that are followed along the way, not only enhance the instruction of the particular tool but also teach computer literacy, keyboarding skills and beginning programming skills.

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